SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JUNE, 1927.

GENERAL PHYSICS.

1592. *Recent Developments in the Art of Fine Measurement.* **J. E. Sears.** (Roy. Inst., Proc. Advance Proof. Received Sept., 1926.)—A lecture on the accurate measurement of length. After reference to official standards, mostly line standards, the new end standards, and the Johansson gauges are described, along with the methods of manufacture, use, and testing. Mechanical and optical means of calibration are explained and a new method of accurate measurement of internal diameters is described. Reference is also made to the use of the valve for measuring small displacements. W. G. B.

1593. *The Accuracy of Measurements of Length, using Measuring Cross Wires in a Theodolite.* **K. Lüdemann.** (Zeits. Instrumentenk. 47. pp. 33–44, Jan., 1927.)—The accuracy obtainable has been determined under working conditions in daylight and at night with theodolites of medium size, using different forms of division for the vertical staff, with fixed and with micrometer horizontal cross wires. The results obtained by two different observers are compared. It appears possible to decide by means of them, in advance, whether the method is suitable for a given purpose or not. H. N. A.

1594. *Density of Boron Trichloride and Suspected Variation in the Atomic Weight of Boron.* **H. V. A. Briscoe, P. L. Robinson** and **H. C. Smith.** (Chem. Soc., J. pp. 282–290, Feb., 1927.)—Boron trichloride is prepared from colemanite (from Death Valley, California), crude boric acid (from Tuscany), and boracite (Asia Minor), and the density of the trichloride is determined with the aid of glass floats as in the previous work on silicon [see Abstract 2255 (1926)] at temperatures between 10 and 12° C., the material being divided by vacuum distillation into three fractions and further subdivided. The mean densities observed were in the order stated, 1·349353, . . 9273, . . . 9211. Apart from traces of impurities (silicon and boric oxide) there seems to be a real difference between the Californian and Asiatic boron, the atomic weights for boron deduced lying between 10·823 and 10·839 (Cal.) and 10·813 and 10·817 (Asiatic mineral). H. B.

1595. *Specific Gravity of Paraffin Wax.* **F. J. Morris** and **L. R. Adkins.** (Indust. and Engin. Chem. 19. pp. 301–302, Feb., 1927.)—

Air was removed from the samples by heating for twenty-four hours to 140° to 150° F. *in vacuo*, cooling in the same vacuum; they were then blue-grey and somewhat translucent. A modified Nicholson hydrometer was used in the measurements, and curves showing the specific gravities of two samples at different temperatures between 30° and 130° F. are given. They show certain irregularities, which are probably connected with the complex nature of the material. H. N. A.

1596. *Diffusion Pump.* **L. Wertenstein.** (Cambridge Phil. Soc., Proc. 23. pp. 578–583, Jan., 1927.)—Discussion of the theory of the "sucking effect" of the diffusion pump, with special reference to the establishment of a pressure gradient along the jet. The influence of the gas is considered, and the possibility of using the diffusion pump for the separation of gases is suggested. W. H. Ge.

1597. *The Passage of a Current of Vapour into a Vacuum in Relation to the Action of Diffusion Air Pumps.* **W. Molthan.** (Zeits. techn. Physik, 8. 2. pp. 80–81, 1927.)—Calls attention to an error in a formula in a previous paper on the same subject [see Abstract 262 (1927)], and gives a corrected table of densities and two other tables. The diagram in the original paper showing the stream lines is not quite correct, as they should be somewhat closer together at the sides of the stream, but the difference is not great enough to require a new diagram. H. N. A.

1598. *A New Type of Aspirator.* **E. L. Harrington.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 87–97, Jan., 1927.)—The aspirator or filter pump is supposed in its action to be an illustration of Bernoulli's principle. In addition, however, the viscosity of the air and its mechanical trapping by the water-jet are factors of great importance. To obtain the best effects the jet must have a high velocity, it must expose a large surface to the air in order to utilise the results of viscosity action, and the exit tube must be designed to ensure stability. All these factors are considered, and the behaviour of the final and most efficient type of pump considered experimentally. This had a three-hole, multiple jet, with a fairly long exposed portion, and a special type of exit tube. It was approximately six times as efficient as two of the best-known types of aspirator utilising the Bernoulli principle. A. A. D.

1599. *An Apparatus for Measuring the Velocity of Absorption of Gases by Liquids.* **P. Riou.** (Comptes Rendus, 184. pp. 195–197, Jan. 24, 1927.)—A glass cylinder, at the bottom of which is a stirrer, is filled with the gas to be tested; a tap is then turned which admits the absorbing liquid into the cylinder until it reaches a mark half-way up; the communication between the gas in the cylinder and the outside atmosphere is closed, and a tap opened joining it to a small vertical graduated tube, which has a side tube through which water is drawn and flows to the bottom of the graduated tube, when the volume of gas in the main cylinder is diminished by absorption in the liquid. The time required for the absorption of 5 or 10 cm.^{3} of gas is thus measured. For high values of the absorption constant a cylinder with a constriction half-way up may be employed, so that the amount of gas and of liquid is not greatly altered, while the surface at which absorption takes place, which is in the constriction, is much diminished. H. N. A.

1600. *A Glass Water Still.* **G. G. Kretchmar.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 187–189, Feb., 1927.)—A glass distilling apparatus for water is described. It consists of a pyrex flask attached to a condenser of the same material in such a way that the water-level is maintained during operation. The heater is a 600-watt element made of nickel-chromium wire and directly immersed in the water. The capacity is about 700 c.c. per hour. The operation is automatic and the efficiency is about 85 %. AUTHOR.

1601. *Mechanical Synthesis of Harmonics.* **E. Rothé** and **A. Rémy.** (J. de Physique et le Radium, 7. pp. 193–199, July, 1926.)—An apparatus for combining simple harmonic motions of differing phase and amplitude is described. A series of mechanical elements, strictly interchangeable, varies the amplitudes of the simple motions by a variable eccentricity. This mechanical series is actuated by a three-phase motor so controlled that it is able to vary the period of the motion. The combined motion of all parts is transmitted to a rotating drum, upon which the resultant motion is recorded. This apparatus can be applied to the synthetic study of seismograms, to the vibrations of traffic, machinery, etc. W. A. R.

1602. *Application of the Calculations of Errors to a Problem of Unsymmetrical Distribution.* **R. Fürth.** (Zeits. f. Physik, 40. 5. pp. 364–367, 1926.)—An unsymmetrical distribution of the measured values of a quantity around its mean value was considered earlier by the author [see Abstract 238 (1922)]. In the present case the motion of heavy particles moving freely in a liquid contained in a vessel with a horizontal surface is considered. An expression is obtained for the probability of occurrence of particles at any given height above the plane surface. This expression is similar to the so-called barometric height formula which holds for the density distribution of a large number of similar particles in a state of stationary equilibrium. R. S. R.

1603. *Resistance to Motion of a Sphere.* **H. Liebster.** (Ann. d. Physik, 82. 4. pp. 541–562, Feb. 26, 1927.)—The motion of steel spheres falling in a liquid was observed kinematographically, the apparent weight of the sphere in the liquid being equal to the resistance at the limiting velocity, which latter is obtained by measurement of the kinematograph records. For Reynolds numbers < 1 the resistance is practically proportional to the velocity, while for Reynolds numbers > 1000 it is proportional to the square. For small velocities, the observed values lie between those calculated from the formulæ of Stokes and Oseen. The effect of the walls of the vessel was allowed for by the formulæ of Ladenberg and Faxen, and measurements of the resistance of spheres falling near the walls agreed with the formula of the latter. At the larger speeds, aperiodic variations of speed and direction were observed, due to the instability of the vortex system caused by the motion. W. G. B.

1604. *Flow of Water through Diverging Passages of Rectangular Cross-Section.* **K. Shôgenji, K. Tanaka, T. Omori** and **I. Naramoto.** (Kyushu Univ. Coll. Eng., Mem. 4. 2. pp. 115–157, 1927. In English.) —The flow of water through diverging passages of rectangular cross-section, two sides being parallel, with various angles of divergence, built up of machined, cast-iron pieces, was experimentally investigated by measuring the quantity flowing and the pressures at several sections in the diverging passage and in the parallel passages before and behind. Attention is paid to the fact that the turbulence at the point of enlargement does not all mean loss, for some of the energy is converted into kinetic or pressure energy; the *true* loss is calculated from the experimental results. The dependence of the loss coefficient on Reynolds' number and upon the angle of divergence is exhibited graphically. For angles of divergence < 13° the true loss in diverging passages is less than that in rectangular passages of section equal to that at entry, being a minimum at about 5°. Incidentally the flow in parallel passages of rectangular cross-section was studied up to $R = 200{,}000$, and the validity of the Stanton-Pannell-Lees formula verified. W. G. B.

1605. *An Absolute Method for Measuring the Velocity of Fluids.* **H. E. Hartig** and **H. B. Wilcox.** (Phys. Rev. 29. pp. 485–490, March, 1927.)—Trains of sound waves from two telephones in series in an oscillating circuit are sent up and down the pipe in which the fluid whose velocity is required is flowing, and the displacement of the antinodes due to flow measured by means of a "sound-probe." By using interrupted wave trains, the effect of reflections at the ends are eliminated. Results are believed to be accurate to within 1 %, and agree closely with those obtained by a smoke-drift method. The possible effect of turbulence is discussed, but in view of the sharpness of the antinodes it is thought to be negligible. At present air only has been used, but experiments with water are in progress. W. G. B.

1606. *A Hydrodynamical Problem. Part II.* **C. W. Oseen.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 4. pp. 1–43, 1927. In German.)—In a previous paper [see Abstract 804 (1923)] the author has examined the possibility of solving two-dimensional hydrodynamical differential equations by means of the method given by Fredholm for the elastic problem, but found limitations to its scope. In the present publication a solution is attempted on the same lines for the three-dimensional case of the problem and attended with definite positive results of general application. H. H. Ho.

1607. *Determination of Certain Hydrodynamical Problems.* **F. K. G. Odqvist.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 30. pp. 1–17, 1927. In English.)—In this paper the author deals mathematically with the two-dimensional hydrodynamical problem for an incompressible fluid, the motion being assumed irrotational and the influence of external forces neglected. It is shown for the case of a jet issuing through an orifice from the top of a tube that a family of possible solutions exists. If the motion is turbulent, the physical realities do not suffice to determine uniformly the solutions of the general hydrodynamical equations, and the laws of motion become statistical by nature. H. H. Ho.

1608. *An Extension of Oseen's Method.* **H. Villat.** (Comptes Rendus, 184. pp. 419–422, Feb. 21, 1927.)—A hydrodynamical theorem. The method of Oseen [see Abstract 804 (1923)] is applied to the case of a fluid of finite dimensions in which a rectilinear lamina is moved parallel to one boundary of the fluid. An expression is found for the thrust on the lamina. G. E. A.

1609. *Long-Range Flight of Aeroplanes.* **J. Vorobeitchik.** (Comptes Rendus, 184. pp. 514–516, Feb. 28, 1927.)—The author discusses mathematically the optimum conditions for horizontal flight of a long-range aeroplane. Certain simplifying assumptions are made, and an expression is found relating the consumption with the other factors involved.
J. W. T. W.

1610. *Rotating Cylinder in Aerofoil.* **K. Frey.** (Zeits. techn. Physik, 8. 1. pp. 8–12, 1927.)—Describes experiments made with aerofoil sections enclosing a rotating cylinder. These measurements were made in the wind tunnel at Hanover and gave promising results. The theory of the system and the lines on which development is indicated are dealt with briefly in the paper. J. W. T. W.

1611. *Influence of Vortices on the Pressures Experienced by a Moving Cylinder.* **W. Müller.** (Zeits. techn. Physik, 8. 2. pp. 62–67, 1927.)—The case of a circular cylinder past which a stream of fluid flows, and two symmetrical vortices behind the cylinder, is fully worked out, and the resultant of the pressure acting on the cylinder found to be a resisting force, which vanishes if the vortices are stationary. The case of a single vortex, and circulation round the cylinder, superposed on a uniform stream is then treated, when the resultant force is inclined to the direction of the stream. The calculated "lift-drag" curve is a parabola, and agrees well with experimental curves for a rotating cylinder. W. G. B.

1612. *Formation of Pendant Drops.* **L. I. A. Micheli.** (Phil. Mag. 3. pp. 581–586, March, 1927.)—An examination of results and methods for the determination of surface tension from the weight of drops.
W. G. B.

1613. *Superficial Tension and Crystalline Faces.* **E. Perucca.** (Accad. Sci. Torino, Atti, 61. 14. pp. 318–334, 1925–1926.)—The existence of a superficial tension at the surfaces of solids resembling that in the case of liquids is admitted, but no direct method of determination is known. The Gibbs-Curie theory yields values generally different for the superficial tension of non-equivalent crystalline faces in equilibrium with the saturated solution from which they are derived, and similarly for a crystal in equilibrium with its own saturated vapour. A different surface tension at crystal faces which are not equivalent is also deduced from the theory of Born. These theories do not sufficiently take account of the effect on the surface tension which may be due to the bound electrons of the superficial atoms. The existence of a superficial amorphous layer may completely modify the theoretical deductions. This paper gives an account of a qualitative method of attempting the solution of the question of the equality or diversity of the surface tension on non-equivalent crystalline faces. The method is applied to fresh faces of cleavage, and has been carried out experimentally with orthoclase. No difference of surface tension was observed. J. J. S.

1614. *Dynamic Surface Tension and the Structure of Surfaces.* **O. K. Rice.** (J. Phys. Chem. 31. pp. 207–215, Feb., 1927.)—The theory of dynamic surface tension is developed from a new point of view, a proof being given on simple thermodynamic grounds that the dynamic surface tension when the surface is extended is greater than the static and less when the surface is contracted. A recapitulation of some of the data in the literature of the subject is given. Considering only the dynamic surface tension of extension, the possibility is discussed that equilibrium might be established between all parts of the solvent, but not established between the portions of the solute which are respectively near the surface and far from it, and it is shown that the narrower the region to which adsorption is confined (in the normal situation after equilibrium is established) the larger will be the value of the dynamic surface tension. If perfect solution laws hold clear to the surface the dynamic surface tension can never be greater than the (static) surface tension of the pure solvent if the adsorption is positive, but where the adsorption is negative an infinite value of the dynamic surface tension is theoretically possible. Du Noüy's determination of the surface tension of sodium oleate solution is discussed, and his results explained on the assumption that his method of the ring tensimeter does not give true static values of the surface tension, but that the "degree of staticness" is determined by the state of the molecules at the surface. A. B. C. L.

1615. *Adhesives and Adhesion: True Chemical Compounds as Adhesives.* **J. W. McBain** and **W. B. Lee.** (Roy. Soc., Proc. 113. pp. 606–620, Jan. 1, 1927.)—Experiments are described showing that pure crystalline substances—*e.g.*, saligenin, Rochelle salt, *p*-hydroxybenzaldehyde—may fully rival well-known adhesives in the strength of the joint obtainable by them, and yield joints between optically polished metal surfaces whose breaking strength (tensile) may approach 1 ton per sq. in. Pure liquids give results of a lower order of magnitude, even when they are only a few millionths of an inch thick. In all cases the thinner film yields the stronger joint. This rule holds for ordinary adhesives as well, provided that the film completely fills the space between the surfaces joined. There is direct parallelism between joint strength and the mechanical properties of the materials joined. Joint strengths increase with tensile strength and elasticity, and fall with atomic volume and compressibility. Good lubricants with high spreading coefficients are poor adhesives. In many cases joint strength is nearly the same, whether tested in tension or in shear. Disorderly molecular arrangement greatly enhances strength and joint strength, and it is hence suggested that crystal grains in pure substances are united by true adhesion, which, in this instance, differs slightly but distinctly from the true cohesion of the same substance in the under-cooled liquid or amorphous state. A. B. C. L.

1616. *Transformation of the Equations of Elasticity.* **Kolossoff.** (Comptes Rendus, 184. pp. 512–514, Feb. 28, 1927.)—Describes a transformation which simplifies the treatment of the equations of elasticity in many cases. The paper is mathematical and cannot be usefully abstracted. **Errata** (*ibid.*, p. 960, April 11, and p. 980, April 20, 1927). J. W. T. W.

1617. *A Note on Certain Experiments on the Supposed Variation of the Coefficient of Viscosity with the Rate of Shear.* **J. W. Lewis.** (Phil. Mag. 3. pp. 429–432, Feb., 1927.)—Molin [see Abstract 193 (1921)] arrived at the conclusion that the viscosity of a very viscous liquid, such as treacle, is dependent on the rate of shear, and the object of the present note is to point out that Molin's conclusion is based on an erroneous interpretation of his experimental results. The viscometer used by Molin is discussed, and pivot friction is taken into account, in consequence of which Molin's conclusion was found to be invalid after his data had received the necessary corrections. H. H. Ho.

1618. *Variation of Logarithmic Decrement with Amplitude and Viscosity of Certain Metals. Part IV.* **G. Subrahmaniam.** (Phil. Mag. 3. [Supplement], pp. 854–863, April, 1927.)—This paper is the fourth and concluding member of the series [see Abstract 1990 (1926)]. In it a study is made of the behaviour of wires of magnesium, zinc, and cadmium. The experimental arrangements are similar to those already described, and the results are given in both graph and tabular form. H. H. Ho.

1619. *Thirty-Third Annual Report of the Committee on Atomic Weights. Determinations published during* 1926. **G. P. Baxter.** (Am. Chem. Soc., J. 49. pp. 583–590, March, 1927.)

1620. *Dielectric Constants and Stark Effect of Polyatomic Dipole Gases, with Symmetrical Molecules, treated by Wave Mechanics.* **C. Manneback.** (Phys. Zeits. 28. pp. 72–84, Jan. 15, 1927.)—The subject has been treated very recently by F. Reiche, who, however, only deals with a first approximation to the linear Stark effect [Abstract 903 (1927)]. The present paper deals more fully with the subject, which has also been treated by Kronig, using Heisenberg's mechanics. In comparing the different theories the behaviour of the " constant " C in the equation for the polarisation M of the gas, $M = N(\gamma + C\mu^2/KT)F$, is considered. The classical theory of Langevin and Debye gave $C = 1/3$ independently of the temperature; it is shown that the deviation according to the new theory in the present case is quite small at ordinary temperature, only a little more than 1 % for NH_3 and less for heavier gases. The value of the dielectric constant tends towards that of the classical theory as high temperatures are approached; this is also the case when Heisenberg's theory is employed in the calculations. The problem is also treated by means of the old quantum mechanics, and it is shown that this gives a considerable deviation from the value 1/3 for the " constant " C at ordinary temperatures, and that it tends towards this value at high temperatures. The original paper should be consulted for the mathematical treatment of the problem, with and without an external electrostatic field, which deals with the various spectra and quantum numbers involved and shows how the splitting up of the line by the Stark effect can be calculated. It is shown that the measurement of the linear Stark effect gives directly the value of the electrical moment μ of the molecule. H. N. A.

1621. *On the Mutual Potential Energy of a Plane Network of Doublets.* **J. Topping.** (Roy. Soc., Proc. 114. pp. 67–72, Feb. 1, 1927.)—Determines the mutual potential energy of small electric or magnetic doublets situated in a plane with axes perpendicular to the plane, reckoning from infinite dispersion of the doublets. Two cases are considered in which the doublets form a simple square and an equi-triangular network respectively; it appears that the mutual potential energy differs only by about 2 % in the two cases. The double summations arrived at are Zeta functions of the second order, and are evaluated by means of formulæ recently given by Lennard-Jones and Ingham. The evaluation for the triangular network is in excellent agreement with that recently obtained by an algebraical method by Chapman, Topping, and Morrall. The mutual potential energy per unit area in the presence of an infinite square network of doublets of moment μ is $W = \frac{1}{2}n^{5/2}\mu^2 . 9{\cdot}0336$, where n is the number of doublets per unit area. For the equi-triangular doublet $W = \frac{1}{2}n^{5/2}\mu^2 . 8{\cdot}8927$. In the case of surface films the experimental errors are such that it is immaterial whether the network is considered square or triangular, and the equation $W = \frac{1}{2}n^{5/2}\mu^2 . 9$ may be employed. H. N. A.

1622. *Theoretical Prediction of the Physical Properties of Many-Electron Atoms and Ions, Mole Refraction, Diamagnetic Susceptibility, and Extension in Space.* **L. Pauling.** (Roy. Soc., Proc. 114. pp. 181–211, March 1, 1927.)—Uses the wave mechanics of Schrödinger to derive theoretical values of screening constants to be used in the equations representing the mole refraction or polarisability, diamagnetic susceptibility and extension in space, on the assumption that the nuclear charge is large in comparison with the charge of an electron shell, a requirement which is not well fulfilled by actual atoms and ions. It is found, however, that the experimental values for the mole refraction of the rare gases differ by only small amounts from those calculated by the new theory, and a modification of the simple theory is made by means of which values are obtained for the mole refraction and diamagnetic susceptibility of a large number of atoms and ions, which are tabulated. In addition to the two screening constants applicable to these two cases a third one is evaluated, which permits the calculation of the electron distribution in atoms and ions and the estimation of interatomic distances. It is shown that the investigation of the diffraction of X-rays by crystals provides a method for the direct experimental verification of the form of Schrödinger's Eigenfunctions. H. N. A.

1623. *Effective Cross-Section of the Oriented Hydrogen Atom.* **R. G. J. Fraser.** (Roy. Soc., Proc. 114. pp. 212–221, March 1, 1927.)—The conditions in the discharge tube were adjusted so that a beam of fast hydrogen canal rays was produced, consisting largely of atoms, charged and neutral. A magnetic field was introduced in the same direction as that of the motion of the atoms, and the neutral atoms, if the Bohr-Sommerfeld atom model is accepted, become oriented parallel and antiparallel to the field direction, with the result that the effective collision area is increased and the mean free path is decreased. There is no such effect for the protons; these can be removed from the beam by a transverse electric field, and the effect of the neutral atoms upon a thermopile can be examined with and without the magnetic field. No sign of the effect of orientation was observed either when the beam passed through hydrogen or through argon, so that the hydrogen atom appears to be isotropic. Unsöld has recently shown spectroscopically that the helium atomic core is not an electric quadripole, as it would be with a plane orbit for the inner electron; this implies an advanced symmetry for the helium atomic core, and hence for the normal hydrogen atom. Spherical symmetry for an s state follows as a necessary consequence of the Schrödinger atomic theory. The normal state of the hydrogen atom is 1s. H. N. A.

1624. *Energy of the Crossed-Orbit Model of the Hydrogen Molecule.* **E. Hutchisson.** (Phys. Rev. 29. pp. 270–284, Feb., 1927.)—Computations are made with the classical quantum theory to determine the energy of a model of the hydrogen molecule similar to the crossed-orbit model of the helium atom with the nucleus divided and separated into two parts. In the preliminary computations the repelling force between the diametrically opposed electrons is neglected, allowing the masses and the charges of the two electrons to be lumped together. This reduces the problem from one of four bodies to one of three bodies, and the computations follow those made by Pauli on the H_2 ion except that the mass and charge of the electron are doubled. The effect of the interaction is then obtained in a manner similar to that used by Kramers for the helium atom. In this method terms with undetermined coefficients are introduced into the perturbing potential. The coefficients are then determined so as to reduce the square of the ratio of the perturbing force to the real force to a minimum. Applying this method to the crossed-orbit model of the hydrogen molecule, the energy of the normal state is found to be 45·2 volts. This value is much higher than that given by experiment (31·42 volts), so that it is necessary to conclude that, according to the older quantum theory, the model does not correspond with reality. AUTHOR.

1625. *Electron Affinity of Hydrogen and the Second Ionisation Potential of Lithium.* **L. Pauling.** (Phys. Rev. 29. pp. 285–291, Feb., 1927.)—On the assumptions that electrons in atoms and ions can be considered to be in hydrogen-like orbits under the influence of an effective nuclear charge $(Z - s)e$, and that the screening constant s is the same for ions with the same structure, there is calculated for the second ionisation potential of lithium the value of 76·2 volts, and for the electron affinity of hydrogen atoms the value − 1·85 k. cal./mol. These values are shown to lie within the range permitted by existing spectral and thermochemical data. With the use of the electron affinity of hydrogen it is shown that theoretically the hydride ion should be unstable in aqueous solution. AUTHOR.

1626. *The Polymorphism of Silicon Dioxide and the Structure of Tridymite.* **R. E. Gibbs.** (Roy. Soc., Proc. 113. pp. 351–368, Dec. 1, 1926.)—After giving a review of the β structures of quartz and crystobalite, a structure has been suggested for the intermediate form tridymite, on the assumption of the conservation of the tetrahedron of oxygen atoms around any silicon as the building unit. X-ray analysis justified this assumption, and showed that the structure of tridymite was similar to that of ice, *i.e.*, with four molecules per cell, in which $a = 5 \cdot 03$ and $c = 8 \cdot 02$. A comparison of structures illustrates how some of the symmetry elements of the tetrahedron have been conserved in each case. It follows that the structures are good examples of that class in which the framework can be considered as a closely packed arrangement of oxygen atoms of diameter about 2·6, while the silicon atoms occupy the spaces formed between four neighbouring oxygens. It is probable that the structures are ionic in nature, being variations of a two-to-one packing of oppositely charged ions. Possible modes of β-β transitions lead to the idea that these sluggish changes are characterised by a change of partners between neighbouring ions. On the other hand, the α-β transition, in the case of quartz at least, and probably in the other forms as well, is merely a small atomic rearrangement not sufficiently drastic to involve a change of neighbours. The α states are probably created by distortions of the β form involving lower symmetry and larger cells. α-tridymite is orthorhombic, having a cell $a = 9 \cdot 9$, $b = 17 \cdot 1$, $c = 16 \cdot 3$, in which the units must be polymerised groups $n\mathrm{SiO_2}$, where n is larger than two and probably equal to eight. Lastly, the existence of a third form of tridymite was confirmed and shown to resemble fairly, as far as could be judged photographically, the ordinary form. AUTHOR.

1627. *Effect of Temperature upon the Crystal Structure of Calcite.* **C. Tsuboi.** (Phys. Math. Soc. Japan, Proc. 8. pp. 197–203, Dec., 1926.) —The effect was studied by examining the Laue photographs of a crystal of calcite taken at high temperatures. On heating the crystal the relative intensity of reflection from $(1\bar{2}\bar{2})$ as well as from $(1\bar{4}\bar{2})$ decreases, while that from (100) increases. But E. Nies found that the intensity of reflection from $(3\bar{1}\bar{1})$ of calcite at the temperature of liquid air is so remarkably stronger than at ordinary temperature that neither Debye's theory nor Waller's can account for the difference. The present writer attributes these changes in the intensity of reflection to the change in the mean relative positions of the atoms of which the crystal is composed. It is therefore concluded that (1) the value of the parameter of the oxygen atoms in the crystal at ordinary temperature is a little less than $0 \cdot 25$, and that (2) the value of the parameter decreases as the temperature is raised. The bearing of the temperature effect on crystal analysis in general is discussed, and a means for the precise determination of the value of the parameter is proposed. AUTHOR.

1628. *Anisotropic Copper, Silver and Gold.* **Sophie Berkman, J. Böhm** and **H. Zocher.** (Zeits. phys. Chem. 124. pp. 83–96, Oct. 28, 1926.)—In colloid copper, silver and gold light vibrations parallel to the lengths of the colloid particles are more strongly absorbed in the longer-waved regions of the spectrum and less strongly absorbed in the shorter-waved regions than are light vibrations at right angles to these lengths. The transition may occur at different points of the spectrum with different specimens of one and the same colloid metal. The dispersion is generally anomalous and the refractive index is smaller for the light vibrations parallel to the particle lengths. Ordinary silver and gold present completely mixed crystalline axes in all directions. A. D.

1629. *Electric Anisotropy of Liquid Crystals.* **W. Jezewski.** (Zeits. f. Physik, 40. 1–2. pp. 153–160, 1926.)—Measurements of the dielectric constant in liquid crystals (*p*-azoxyphenotol and *p*-azoxyanisol), with and without a magnetic field, at different temperatures and at different angles between the magnetic and the electric lines. Comparison of Ornstein's theory [see Abstract 2388 (1924)] with data of observation. They agree only in strong magnetic fields. A. D.

1630. *Refractivity of Anistropic Molecules.* **T. H. Havelock.** (Phil. Mag. 3. pp. 433–448, Feb., 1927.)—The molecule is treated as a structure of isotropic polarisable constituents in fixed relative positions. Expressions are obtained, in terms of the constants of the constituents and of the structure, for the refractivity and depolarisation ratio of a gas whose molecules are of the following types: (1) Three equal atoms at the corners of an equilateral triangle, with a fourth atom equidistant from them but not necessarily in the same plane; (2) four equal atoms at the corners of a regular tetrahedron, with a fifth atom at the centroid; (3) four equal atoms at the corners of a square, with a fifth atom equidistant from them but not necessarily in the same plane. Numerical applications are made to some molecular models which have been proposed for NH_3 and CH_4, and the results are discussed in relation to other members of the series of compounds of the form XH_n. T. M. L.

1631. *Crystal Structure of Some Oxalates.* **J. F. Wood.** (Univ. of Durham Phil. Soc., Proc. 7. 3. pp. 111–116, 1925–1926.)—From X-ray data the author deduces that in oxalic acid the unit cell has the dimensions $a = 6 \cdot 10$ Å., $b = 3 \cdot 61$ Å., $c = 12 \cdot 05$ Å., β the angle between a and c $= 106° 12'$; two molecules, type A, per cell with one at each corner, and one, type B, at the centre. The molecule has a centre of symmetry, and type B is obtained from type A by reflection across the symmetry plane; this is necessary in order to account for the abnormal values of the spacings of certain planes; space group C_{2h}^5. Ammonium oxalate, with two molecules per unit cell, has $a = 8 \cdot 06$ Å., $b = 10 \cdot 34$ Å., $c = 3 \cdot 82$ Å., space group Q_3. The molecule has a digonal axis coinciding with the crystallographic C axis. The molecules are arranged one at each corner and one at the centre of the (001) faces. Methyl oxalate, $a = 3 \cdot 93$ Å., $b = 11 \cdot 84$ Å., $c = 6 \cdot 17$ Å., $\beta = 103° 22'$, space group C_{2h}^2, two molecules per unit cell; the second molecule is half-way along the b edges of the cell. The molecule has some symmetry of its own, either a plane or a centre of symmetry. H. N. A.

1632. *Crystal Structure of Solid Oxygen.* **J. C. McLennan** and **J. O. Wilhelm.** (Phil. Mag. 3. pp. 383–389, Feb., 1927.)—Wahl [Abstract 1071 (1913)] found by the polarising microscope two forms of solid oxygen, one hexagonal between − 230° and − 219°, and one indeterminate. Recently Keesom and de Smedt found identical diffraction patterns with solid oxygen and nitrogen without deduction of the type. The writers find different patterns at the temperature of liquid H_2. A powder pattern was obtained and measured of solid oxygen at − 252°. It is found that oxygen crystallises in a body-centred orthorhombic system with axial ratios $a : b : c = 1 \cdot 44 : 1 : 9$. The density works out to $1 \cdot 46$. J. E.

1633. *Tensile Deformation of Large Aluminium Crystals at Crystal Boundaries.* **R. L. Aston.** (Cambridge Phil. Soc., Proc. 23. pp. 549–560, Jan., 1927.)—Gives in detail results of extension tests upon an aluminium rod consisting of three crystals of which the orientations were determined by the X-ray methods given in another paper [see next Abstract]. W. H. GE.

1634. *Determination of Crystal Orientation.* **R. L. Aston.** (Cambridge Phil. Soc., Proc. 23. pp. 561–577, Jan., 1927.)—Deals with devices useful in the determination by X-ray methods of the directions of the axes in single crystals of metals. Tables facilitating calculations for aluminium and iron crystals with an iron antikathode are given. W. H. GE.

1635. *Lattice Spacing and Rhombohedral Angle of Magnesium Carbonate.* **J. Brentano** and **W. E. Dawson.** (Phil. Mag. 3. pp. 411–418, Feb., 1927.)—An accurate determination has been carried out with a micro-crystalline powder using an X-ray photographic method, and the results are $a_0 = 103° 19'$, $d_{100} = 5 \cdot 477 \pm 0 \cdot 005$ Å., $a = 5 \cdot 899$ Å. and density $= 3 \cdot 000$ gm./cm.^{3}. W. H. Ge.

1636. *Lattice Structure and Electrical Conductivity of Alloys.* **C. H. Johansson** and **J. O. Linde.** (Ann. d. Physik, 82. 4. pp. 449–478, Feb. 26, 1927.)—Detailed study of the series of mixed crystals Au-Cu, Pd-Cu and Pt-Cu. W. H. Ge.

1637. *The Possibility of the Existence of Limiting States in Alloys.* **L. Grenet.** (Rev. de Mét. 24. pp. 93–107, Feb., 1927.)—In the transformation of a substance from one crystal form to another it is usually supposed that one lattice passes abruptly into the other type. Such is the case when α iron (body-centred) passes into γ iron (face-centred). Even when an alloy of two components transforms (although the transformation may extend over a range of temperature), yet nevertheless it is supposed that the passage from one form of lattice to another is discontinuous. Such is the case with the ferro-nickels. The present paper explores another possibility. It may be that the transformation takes place by a continuous modification of one lattice until it is equivalent to the new form. The argument is roughly similar to that employed in the application of van der Waals' equation to the transformation of a gas into a liquid. It involves the conception of a critical pressure and temperature, and explains discontinuous changes as being due to a type of instability. The argument is applied first to the transformations of iron and then to those of the ferro-nickels. It is illustrated with numerous hypothetical diagrams, without which it is impossible to summarise the paper. The views advanced are admitted to be tentative. A. A. D.

1638. *Crystal Structure of Magnesium Platinocyanide Heptahydrate.* **R. M. Bozorth** and **F. E. Haworth.** (Phys. Rev. 29. pp. 223–230, Feb., 1927.)—The positions of the Mg and Pt atoms in crystals of $MgPt(CN)_4 . 7H_2O$ have been definitely determined by means of X-ray oscillating-crystal photographs and Laue photographs, using the theory of space-groups. Because the other atoms are too light in comparison with the metal atoms, especially Pt, their positions could not be determined. The Pt atoms are located at 0 0 0 and ½ ½ ½, the Mg atoms at 0 0 ½ and ½ ½ 0, in a tetragonal unit of structure 14·6 Å. × 14·6 Å. × 3·13 Å. Two units of structure are shown in the figure. The peculiar optical properties are believed to be associated with the unusual arrangement of the heavier atoms in widely spaced rows parallel to the tetragonal axis. In these rows Mg atoms alternate with Pt atoms, and the distance between any two adjacent atom-centres is 1·57 Å. The shortest distance between rows, however, is 10·3 Å., 6·6 times the distance between atoms in the same row. The atomic radii of Mg and Pt as determined by Bragg from other crystal data do not agree with the observed distance between these atoms, the calculated value being 2·7 Å., the observed distance 1·57 Å. The observed distance, however, is consistent with that calculated by the method of Davey, who assumes that the radius of an ionised atom differs much from the radius of the same atom un-ionised, and that the radii of Cs^+ and I^- are substantially equal in crystals of CsI. AUTHORS.

1639. *Some Theoretical Determinations of the Structure of Carbonate Crystals.* **J. E. Lennard-Jones** and **Beryl M. Dent.** (Roy. Soc., Proc. 113. pp. 673–689, Jan., 1927.)—Consists of two papers of a series, the calculations being based on those of Chapman, Topping, and Morrall [see Abstract 1750 (1926).] Neglecting van der Waals' repulsive and polarisation forces and considering electrostatic and intrinsic repulsive forces only, it is shown how the energy of formation of the crystals is related to the interatomic distances and the rhombohedral angle. For stability this energy (U) should be a maximum (potential energy a minimum). $U_{max.}$, assuming distance between C and O(*b*) = 0·95 Å., gives not quite satisfactory agreement with the observed parameters *a* and α, the value of *b* giving best agreement with theory is 1·08 Å. both for $MgCO_3$ and $CaCO_3$. In the second paper a method of finding the force constant of repulsion between various ions, Zn, Fe, Mn, Cd and O, is given assuming the index *n* of the repulsive power known (10 or 11). It was shown in the first paper that the forces between the metallic ions have little effect on the configuration, which explains the small change in shape and size of various carbonate unit cells. $U_{max.}$ is a function of μ_{12}, the force constant between the CO_3 and metal ions, and consequently of *a*, the distance between C and metal ions in the same plane. A comparison of observed values of *a* for $ZnCO_3$, $FeCO_3$, $MnCO_3$ and $CaCO_3$ gives two sets of values for μ_{12} according as $n_{12} = 10$ or 11. To distinguish between the two the results are applied to other crystals in which these ions occur together (MnO, CdO, FeO, ZnO). $n_{12} = 11$ gives the best agreement, and results finally in definite values for the heats of crystallisation and the rhombohedral angles.
J. E.

1640. *Preparation and Optical Properties of Calcium Hydroxide Crystals.* **F. W. Ashton** and **R. Wilson.** (Am. J. Sci. 13. pp. 209–218, March, 1927.)—The properties of crystallised calcium hydroxide may be briefly summarised as follows: (1) Calcium hydroxide crystallises in the hexagonal system usually as plates or short hexagonal prisms, with perfect cleavage parallel to the face (0001). (2) The refractive indices are $\omega = 1\cdot574 \pm 0\cdot003$, $\epsilon = 1\cdot545 \pm 0\cdot003$ for sodium light; birefraction is 0·029; specific gravity 2·230 ± 0·005; interference figure is uniaxial negative; lattice constants are $a_0 = 3\cdot579$ Å., $c_0 = 5\cdot028$ Å. The unit cell contains one molecule. (3) The crystals are non-hydrated $Ca(OH)_2$, fairly stable in air, only slowly dissolved by water. When exposed to moist air or to water containing carbon dioxide they tarnish in a short time, becoming covered by a crust or carbonate. AUTHORS.

1641. *Various Crystalline Forms of Long-Chain Organic Compounds and Difficulties of Interpretation of their X-Ray Spectra.* **J. Thibaud.** (Comptes Rendus, 184. pp. 24–26, Jan. 4, 1927.)—Stearic acid gives usually a spacing $d = 39\cdot9$ Å. By evaporation of an ether solution of the acid on a clean glass plate the author has obtained a double series of lines corresponding to $d_B = 44\cdot6$ Å. and $d_C = 40$ Å. The pure fatty acids can crystallise in various forms, with their carbon chains of different lengths. The results are illustrated in a diagram, which also gives spectra corresponding to cacao butter and a mixture of butters. The author concludes that various pure fatty acids can be distinguished from each other when not mixed together, but that the spacing *d* of an orientable organic substance is subject to variation according to its origin, its mode of preparation, and its degree of purity. T. B.

1642. *A Note on the Connection between Chemical Valency, Electron Grouping and Crystal Structure.* **W. Hume-Rothery.** (Phil. Mag. 3. pp. 301–305, Feb., 1927.)—Draws attention to certain points in connection with the crystal structure of elements and compounds in a paper by Grimm and Sommerfeld. They take the fact that C, Si, Ge, Sn and Pb, which stand four places before an inert gas, with the exception of Pb, crystallise in the diamond type of lattice as confirming the Stoner classification, according to which all five contain two complete sub-groups of two electrons each, and require an additional group of four electrons in order to reach the (2, 2, 4) grouping characteristic of the rare gases. The author shows that the electronic configuration in the diamond must be profoundly different from that in the metallic crystals of Si, Ge and Sn, and that the mere similarity of the atomic lattices cannot as yet be regarded as indicating any particular electronic grouping. Other instances are given to show that the subject is full of apparent contradictions and anomalies. The author disagrees also with the conclusion that all the elements and compounds C, CSi, Si, BN, AlN and BeO are non-polar compounds (or elements) in the solid state, and that the atoms are held together in the solid in the same way as the atoms of carbon in the diamond lattice. The X-ray evidence is shown to be inconclusive, and special difficulties which arise in the cases of AlN and BeO are emphasised. H. N. A.

1643. *X-Ray Investigation of Optically Anomalous Crystals of Racemic Potassium Chlorosulphoacetate.* **W. G. Burgers.** (Roy. Soc., Proc. 114. pp. 222–229, March 1, 1927.)—The optical anomalies of the crystals in polarised light have been described by Jaeger, who concluded that, though apparently orthorhombic, they are built up of perpendicularly crossed monoclinic lamellæ. Using X-ray methods, the author finds $a = 8 \cdot 58$ Å., $b = 8 \cdot 60$ Å., $c = 23 \cdot 76$ Å. The unit cell contains eight salt molecules and twelve water molecules; eight of the latter are probably connected with the sulpho groups of the salt molecules, while the remaining four must occupy special positions either at centres of symmetry or on dyad axes. The halvings observed correspond to the space-group Q_h^{14}, the underlying lattice being the simple orthorhombic lattice Γ_0. This is a strong argument for assuming that the crystals are truly orthorhombic. It is necessary to assume that the successive zones which show themselves in polarised light are orthorhombic, and are produced by a crystal growth which has taken place in steps, and this is confirmed by Laue photographs. It is suggested that the optical anomalies are due to strains in the crystals. H. N. A.

1644. *Non-Combining Terms in the New Quantum Theory. Part I.* **E. Wigner.** (Zeits. f. Physik, 40. 7. pp. 492–500, 1926.)—Using the methods of Schrödinger's wave mechanics, it is shown in Part I that in a system with three electrons the terms fall into several groups, the members of different groups not combining. One of these groups is shown to satisfy Pauli's rule, and for the other the equilibrium distribution is given by the Bose-Einstein statistics. W. S. S.

1645. *Non-Combining Terms in the New Quantum Theory. Part II.* **E. Wigner.** (Zeits. f. Physik, 40. 11–12. pp. 883–892, 1927.)—In Part II the treatment [see preceding Abstract for Part I] is extended to the polyelectronic system, when it is shown that for any symmetrical disturbance the characteristic functions and values of the system are not concerned in the disturbance. H. H. Ho.

1646. *The Symmetrical Top in the Undulatory Mechanics.* **R. de L. Kronig** and **I. I. Rabi.** (Phys. Rev. 29. pp. 262–269, Feb., 1927.)—Schrödinger's method for determining the energy levels of an atomic system is applied to the case of the symmetrical top (moment of inertia about axis of symmetry C, the other one A). The energy values are found to be

$$W_{jn} = \frac{h^2}{8\pi^2}\left[\frac{1}{A}j(j+1) + \left(\frac{1}{C} - \frac{1}{A}\right)n^2\right]$$

in agreement with the result obtained by Dennison from the matrix mechanics. The quantum numbers j and n must be integers restricted by $0 \leqq j, |n| \leqq j$, while half-integral values are not permissible. The intensities of transitions are also calculated. [See Abstract 52 (1927).] AUTHORS.

1647. *A Proposition in Space Quantisation.* **K. Knopp.** (Zeits. f. Physik, 41. 1. pp. 20–23, 1927.)—This is a mathematical proof of the theorem of the independence of the result of vector addition of quantum numbers of the order in which the addition is made. A proof has previously been given by R. de L. Kronig. [See Abstract 2018 (1926).] T. B.

1648. *The Problem of Several Bodies and Resonance in Quantum Mechanics. Part II.* **W. Heisenberg.** (Zeits. f. Physik, 41. 4–5. pp. 239–267, 1927.)—The spectra of atomic systems with two electrons have previously [see Abstract 297 (1927)] been shown capable of quantitative description by means of quantum mechanics. These quantum principles have now been applied to atoms with several electrons, and in particular the problem has been investigated as to the manner in which the resonance phenomena are connected with the multiplet structure of the term systems of complex atoms. The same resonance phenomenon has also been studied in the theory of molecules and their band spectra, and deductions made concerning the significance of the known intensity anomalies in certain rotation bands. H. H. Ho.

1649. *The Quantum Theory of Continuous Spectra.* **J. R. Oppenheimer.** (Zeits. f. Physik, 41. 4–5. pp. 268–294, 1927.)—In this mathematical paper the general theory of systems with extended spectra is first discussed, following which application is made to the hydrogen atom, the continuous Röntgen absorption coefficients, the polarisation and intensity distribution of the Brems radiation, and the velocity and directional distribution of the photoelectrons. The Compton and Kramers formulæ are found to be confirmed. H. H. Ho.

1650. *Electrodynamics and Wave Mechanics from the Standpoint of the Correspondence Principle.* **O. Klein.** (Zeits. f. Physik, 41. 6–7. pp. 407–442, 1927.)—This paper, which is mainly mathematical, opens with a survey of the basis of the wave mechanics of single electron problems and the relativistic theory of Schrödinger. The correspondence principle is then applied to the Maxwell-Lorentz theory, and finally the disturbance of atoms by outside forces and the Compton effect are discussed from the same point of view. G. E. B.

1651. *Magnetic Deflection by Hydrogen Atom Rays.* **E. Wrede.** (Zeits. f. Physik, 41. 8-9. pp. 569-575, 1927.)—In this investigation the Gerlach-Stern method of magnetic deflection by molecular rays [see Abstract 2055 (1922)] has been applied to hydrogen atoms. Experimental details are included in the paper. The magnetic moment of the H-atoms was found to correspond to a Bohr magneton. H. H. Ho.

1652. *The Directing Field of Quantum Mechanics.* **P. Gruner.** (Zeits. f. Physik, 41. 8-9. p. 710, 1927.)—The present note relates to the recent work of Born [see Abstracts 2532 (1926); 43 and 568 (1927)] connecting the Heisenberg-Born-Jordan conceptions with the de Broglie-Schrödinger quantum mechanics. In it the author points out that, in an entirely different investigation carried out in 1925, he proposed similar ideas (*Archives d. Sciences phys. et natur,* 1925, (5) 7, 342), from which it was deduced that the electromagnetic charges present determined a purely geometrical energyless directing field, and that the actual motion of the light quanta ensued according to laws of probability. H. H. Ho.

1653. *Wave Mechanics and the Correspondence Principle.* **P. Debye.** (Phys. Zeits. 28. pp. 170-174, Feb. 15, 1927.)—The author shows that just as Bohr has proved for the classical quantum mechanics that asymptotic frequencies must be given such as would be expected according to the Maxwell-Lorentz equations of electrodynamics, so it is possible to establish a similar correspondence from the hypotheses of wave mechanics. Since, however, the new theory gives simultaneously frequencies and intensities, its hypotheses are shown to be more intimately connected with the ordinary electrodynamics than was the case with the older quantum theory. This correspondence is illustrated very neatly in the paper by the general system with one degree of freedom. [See Abstract 2534 (1926).] H. H. Ho.

1654. *Matrix and Wave Mechanics.* **R. H. Fowler.** (Nature, 119. pp. 239-241, Feb. 12, 1927.)—A description of the lines upon which the matrix and wave mechanics have developed. A classical system in a multiply periodic state can be completely described by a Fourier series of which the frequencies and coefficients are defined by the state. In atomic systems it is necessary to make the description dependent on two states, and a matrix rather than a Fourier series is the appropriate form. A successful matrix mechanics has been developed. From an entirely different point of view Schrödinger has developed a wave mechanics which extends the analogy of the Hamiltonian treatment of dynamics with optics to the cases where the ray theory of light propagation is inadequate and diffraction effects occur. Schrödinger's theory leads naturally to the existence of stationary states. It seems probable that the two forms are almost if not quite equivalent to each other. A. Wh.

1655. *Physical Aspects of Quantum Mechanics.* **M. Born.** (Nature, 119. pp. 354-357, March 5, 1927. Paper read before the British Assoc., Oxford, Aug., 1926.)—The present status of quantum mechanics has already been described by Heisenberg [see Abstract 2532 (1926)], the founder of the new theory, and this paper records an attempt to understand the physical significance of the quantum theoretical formulæ. It is pointed out that the different formulations—the matrix theory, Dirac's non-commutative algebra, Schrödinger's partial differential equations—form, as a whole, a single theory, which enables the computation of the stationary states of atoms and the corresponding radiation. The author then discusses some attempts, based on the new mechanics, of treating the problem of the course of the phenomena when equilibrium is disturbed. Examples are given of the evaluation of a field of force by counting, *i.e.*, by statistical methods and not by the measurement of an acceleration and Newton's second law. The wave-function ψ, which enables the course of a physical process to be followed in so far as it is quantum mechanically determinate, not in a causal but a statistical sense, is discussed at length. Of the associated philosophical problems only the points of view are briefly sketched which are compelled by the whole of physical evidence. The paper concludes with a short consideration of whether the classical formula can be derived as a limiting case of quantum mechanics. H. H. Ho.

1656. *The Relativity Law of Refraction. An Illustration of the Transition from an Observer's Space to the Fourfold and from the Fourfold to Another Observer's Space.* **D. B. Mair.** (Phil. Mag. 3. pp. 448–459, Feb., 1927.)—The laws of refraction under the conditions specified are discussed mathematically. J. S. G. T.

1657. *The Companion of Sirius and the Theory of Relativity.* **G. v. Gleich.** (Zeits. f. Physik, 41. 10. pp. 743–752, 1927.)—The author contends that that the shift of spectral lines due to the companion of Sirius, discussed by W. S. Adams, cannot be accepted unequivocally as evidence in support of the general theory of relativity. J. S. G. T.

1658. *Relativistic Quantification of Continuous Systems.* **T. de Donder.** (Comptes Rendus, 184. pp. 439–441, Feb. 21, 1927.)—The method applied by the author to the relativistic quantification of continuous systems having f degrees of freedom [see Abstract 2267 (1926)] is applied to systems conforming to the wave mechanics of de Broglie and Schrödinger. J. S. G. T.

1659. *Alteration of Riemann Curvature on Introducing Electric Potential into the Fundamental Tensor.* **E. Reichenbächer.** (Zeits. f. Physik, 40. 3–4. pp. 255–269, 1926.)—Investigates the effect of substituting $\nu_{\mu\nu} = g_{\mu\nu} - \frac{e^2}{m^2}\phi_\mu\phi_\nu$ for $g_{\mu\nu}$. The curvature scalar is altered and admits of a large series of new invariants. A. D.

1660. *The Derivation of Energy from Action.* **P. du Val.** (Phil. Mag. 3. pp. 477–481, Feb., 1927.)—The manner in which the world may be "self-gauging" is discussed. Eddington's natural metric presents itself both as gravitational potential whose gradient multiplied by "mass" gives "force" and as lowering a tensorial suffix to convert "mass" to "energy." Further, the natural metric defines the geodesics which are the world-lines of particles in empty space. J. S. G. T.

1661. *The Ratios existing between Geoidal Constants and the Values of Gravity.* **C. Somigliana.** (Accad. Lincei, Atti, 5. pp. 11–16, Jan. 2, 1927.)—In determining the fundamental constants of the geoid, the measurements of gravity at the earth's surface have hitherto been utilised on the basis of Clairaut's formula $\frac{gp - ge}{ge} + s = \frac{5}{2}\frac{\omega^2 a}{ge}$, gp and ge being respectively the values of gravity at the pole and the equator, ω the velocity of the earth's rotation, a the major semi-axis of the ellipsoid of rotation, assumed to represent the geoid, and s the flattening. This last quantity is thus linearly determined when, in addition to gp, ge and ω, the length of a is known. The conviction was thus reached that measurements of gravity, while leading to the determination of the shape of the terrestrial ellipsoid, could never establish its absolute dimensions. The author's object is to show that this conviction is at variance with reality and that it is possible solely by such measurements to achieve the determination of the three fundamental constants of the geoid: the major axis a, the flattening s and the mean density k. Mathematical analysis leads to the conclusion that between any three values of gravity at the surface of the ellipsoid of rotation there exists a homogeneous linear ratio. This ratio results in a biquadratic equation which determines the eccentricity as a function of any three values of gravity and of their corresponding latitudes. The problem is thus reduced to the resolution of an equation of the second order. E. F.

1662. *New Results of the Michelson Experiment.* **A. Piccard** and **E. Stahel.** (Comptes Rendus, 184. p. 152, Jan. 17, 1927.)—To complete former results [see Abstract 60 (1927)], experiments have been made in the authors' laboratories in Brussels. An ether drift equal to that found by Miller (*viz.*, 8·91 km./sec.) would correspond with the authors' apparatus to a band shift of 0·0057. That actually found is 0·0002 ± 0·0007. F. S.

1663. *Relative Velocity of Earth and Ether.* **E. Brylinski.** (Comptes Rendus, 184. pp. 192–193, Jan. 24, 1927.)—It is here pointed out that Piccard and Stahel's results [see preceding Abstract] really confirm Miller's conclusions. The latter found 2·5 km./sec. at Cleveland and 9 km./sec. at Mount Wilson (altitude 1800 m. approximately). Piccard and Stahel find 1·7 km./sec. at Brussels and 7 km./sec. in a balloon at an altitude of 2500 m. F. S.

METEOROLOGY AND GEO-PHYSICS.

1664. *Coloured Clouds.* **P. Barreca.** (N. Cimento, 3. pp. 281–296, Nov., 1926.)—Follows up a previous paper [see Abstract 2312 (1926)] with numerical data and discussion. The sunlight, investing the terraqueous globe, produces at the boundary of the illuminated part a peculiar diffraction, which gives rise to a colossal double circular spectrum formed of concentric spectral rings, in each of which the red is nearest the earth. The phenomena cannot be explained by an atmospheric absorption unequal for different wave-lengths. A. D.

1665. *Observations of Optical Phenomena in the Atmosphere. Altitude of Striæ, the Preliminary Signs of Weather.* **C. Gallssot** and **(Miss) E. Bellemin.** (J. de Physique et le Radium, 8. pp. 29–50, Jan., 1927.)—By a systematic study of the scintillations of stars, flickering shadows and changes in the form of images evidence was obtained of the existence of a boundary of separation between two currents of air of different temperatures or humidities. Details are given of the experimental details and photographs of typical images of different types. By measurements of these shadows the height of this disturbed boundary can be calculated. The observations are spread over a period of six years. A seasonal variation in the height of the layer was found with maxima at the equinoxes and minima at the solstices. When the layer is between 2500 and 4500 metres above the surface it was found that a marked increase of cloudiness and of rain occurred a definite number of days later. The farther the layer is outside these limits the less becomes the amount of cloud at the later epoch. By observations of scintillations produced by this layer the authors consider it is possible to forecast the cloud and precipitation ten to fifteen days in advance. No theory is advanced to explain the phenomena. R. S. R.

1666. *Periodicities in Rainfall, Pressure and Temperature at Certain European Stations.* **D. Brunt.** (Roy. Meteorolog. Soc., J. 53. pp. 1–25; Disc., 25–30, Jan., 1927.)—Twelve sets of data were employed, each extending over at least 100 years, and the period commencing at or near to 1764 was selected. The data examined were rainfall at Milan, Padua, London and Edinburgh, pressure at Paris and Edinburgh, and temperature at London, Edinburgh, Paris, Berlin, Vienna and Stockholm. Annual mean values were employed for periods exceeding ten years and monthly means for the shorter ones. The methods of computation and the periodograms obtained are given earlier [see Abstract 239 (1926)]. General remarks are made on these periodograms. From these forty-four periods are given as significant, ranging from twelve and a third months to thirty-five years, and the particular sets of data to which they apply are shown. These results and those of other workers show that definite surges occur in these meteorological elements and that they exist over considerable zones of the earth's surface. They are stated to be periods of oscillation of the whole or part of the earth's atmosphere, and may be periods of oscillation of the general circulation of the earth's atmosphere possibly set in motion by external causes. An analysis of periods near to one year was also made in case beats should furnish an explanation of the Bruckner cycle. In the *Discussion*, **G. Walker** gave even more periods from an examination of Edinburgh pressure and Milan rainfall, but found no periods more marked than could be given by pure chance. **F. J. W. Whipple,** from diagrams of the amplitudes and phases of the components of London temperature, found a scatter comparable with those due to chance. The author in reply disagreed with these interpretations of the results. R. S. R.

1667. *Period of Simple Vertical Oscillations in the Atmosphere.* **D. Brunt.** (Roy. Meteorolog. Soc., J. 53. pp. 30–31; Disc., 32, Jan., 1927.) —For unit mass of air the general expression for a vertical oscillation takes the form of a simple harmonic motion. For an isothermal layer of the atmosphere with T = 300 Å. the period is 350 seconds for dry air and about 8 minutes for saturated air, assuming in the latter case that no raindrops fall out. With greater temperature lapse rates the period increases, becoming infinite for an adiabatic layer. Microbarograms indicate most frequently periods of 6–10 minutes, and the solution provides a possible help in investigating these oscillations of pressure. In the *Discussion*, **F. J. W. Whipple** suggested that the period obtained was only approximate, since the motion of the surrounding air was not dealt with. R. S. R.

1668. *The Making of a Salt Haze.* **J. S. Owens.** (Phil. Mag. 2. pp. 1165–1170, Dec., 1926.)—Records of atmospheric impurity have been obtained on two occasions which probably represent the intermediate state between a haze of dry crystals and a fog of liquid drops—(1) on March 19, 1926, off the rocky western coast of Spain, and (2) at Holme, Norfolk, on September 1, 1926, when a strong wind was blowing from the sea and had swept over a large expanse of sandy foreshore before the record was taken. The crystalline matter in the earlier deposit behaved very similarly to sea salt under changes of humidity. Although large numbers of salt crystals were found in the later records, the humidity for deliquescence of the crystals was about 5 % higher than that for common salt. A haze formed from surface spray may be a mixture of all salts present, but the particles freed from blowing sand need not have the same composition as sea salt owing to the selective deliquescence of the salts. A. W. L.

1669. *Spectrum of the Aurora and the Constitution of the Upper Atmosphere.* **J. C. McLennan.** (Roy. Inst., Proc. Advance Proof. Received Sept., 1926.)—A review is given of earlier work on the composition, temperature and other properties of the stratosphere and of still high levels of the atmosphere. The general features of the aurora are then examined and the results of spectroscopic examination of it and of the light from the night sky. Babcock's experiments on the auroral green line are discussed and Vegard's theory of solid nitrogen in these upper levels to account for this line of wave-length 5577·35 Å. The author's experiments on the phosphorescence of solid nitrogen, when bombarded with high-speed electrons, discounted this view of Vegard's, while lines were found which were absent from the auroral spectrum and from that of the night sky. The author and Shrum found this line in the spectrum when O was mixed with an excess of He, Ne or A, while Zeeman resolution shows it to be an atomic spectral line and due to O. It does not fall into any older series and term scheme of the arc spectrum of O, and a probable solution is suggested with the O in the auroral regions in an atomic form which can be reproduced in the laboratory but is different from its common atomic form. Probably the atomic form of oxygen required for the emission of the radiation of the auroral green line is one of the products of the dissociation of ozone into oxygen. R. S. R.

1670. *Contribution to the Study of Fulminating Material. The Spontaneous Decomposition of a Variety of Globular Lightning without Appreciable Noise.* **E. Mathias.** (Comptes Rendus, 184. pp. 312–314, Feb. 7, 1927.)—The spontaneous decomposition of homogeneous unelectrified masses of fulminating material is not dangerous, but if the distribution of temperature throughout the mass is heterogeneous successive partial

explosions may cause incandescent matter to be emitted. The red globes are particularly dangerous, being usually the most highly charged.
A. W. L.

1671. *Physical Properties of Icebergs and a Method for their Destruction.* **H. T. Barnes.** (Roy. Soc., Proc. 114. pp. 161–168, March 1, 1927.)—The investigation was undertaken to find a means to hasten the disruption of icebergs. A preliminary study of glacier ice and icebergs showed their granular structure and the deep blue colour due to the scattering of light by large ice molecules. The greatest natural disruption occurred at or immediately after sunrise. Temperature measurements with a microthermometer proved that an iceberg is surrounded by a zone of water of higher temperature than the currents in which it is carried. Chemical tests showed that iceberg ice is at least as pure as distilled water, while the enclosed air has approximately the same composition as the atmosphere. Tests were made with large charges of thermit and bermite on three icebergs, and, apart from the initial disruptive effect, the disintegrating effect of the heat treatment continued for a considerable time later. **R. S. R.**

1672. *Centroids, etc., of the Oceans.* **M. Brillouin.** (Comptes Rendus, 182. pp. 1437–1440, June 14, 1926.)—The distribution of land and water must influence the forces acting on the earth's crust. The centre of gravity of the oceans and the inertia elements are calculated from Bartholomew's maps in *The Times Atlas.* The centre of gravity of the oceans occurs 1320 km. from the earth's centre at long. 150° W. and lat. 46° S.—almost at the antipodes of Odessa. Other figures relating to the effects of the land distribution are given. **W. A. R.**

1673. *Compression Regions.* **J. W. Evans.** (Nature, 119. pp. 15–17, Jan. 1, and pp. 55–58, Jan. 8, 1927. Presidential Address read before the Geological Soc., London, Feb., 1927.)—The present position as regards mountain building is rapidly surveyed. The view is maintained that it results largely in great accumulations of sediment, and the accumulated effects of radioactivity in the crust are discounted. Two great systems of mountain building are detected. One of these has its folding axes orientated along latitude parallels, and would seem to be due to meridional forces. The other is associated with the great ring of compression around the Pacific, determined by a general drift of continental masses towards the centre of the Pacific, caused by a maximum of gravitation beneath it. To these two systems, their intersection and interference, may be referred nearly all the orographical features of the globe. **W. A. R.**

1674. *Origin of the Earth.* **H. L. Fairchild.** (Science, 64. pp. 365–371, Oct. 15, 1926.)—This paper gives a comparison from the geological standpoint of the effects of the nebula and planitesimal theories of the earth's origin. The author concludes that most of these geological considerations favour the planitesimal hypothesis of Chamberlin and Moulton.
W. A. R.

1675. *Mountain Building.* **C. Schuchert.** (Am. J. Sci. 12. pp. 277–292, Oct., 1926.)—This paper gives an account of H. Stille's analysis of mountain structures and occurrence in time space. All forms of structure may originate at one and the same period of building. All folded and block mountains result from upward movements relative to sea-level. The same force gives rise to all kinds of mountain structure. Isostasy is opposed to mountain building, and is secondary and local in effect. The actual type of structure depends upon the mobility of the subsurface. Folding results from mobile ground and block-faulting from resisting ground. W. A. R.

ASTRO-PHYSICS.

1676. *A Particular Case of Diffraction of Solar Images.* **M. Hamy.** (Comptes Rendus, 184. pp. 349–351, Feb. 14, 1927.)—In continuation of earlier papers [see Abstract 2045 (1926)] a development is given of the integral

$$L_{2\sigma} = \int_{C} \frac{(1-u)^{\sigma-1/2}}{(u-a)^2} \cos 2m(u-a)du \int_{-1}^{+1} \frac{1-\cos 2nz\sqrt{1-u^2}}{z^2}(1-z^2)^{\sigma}dz.$$

The paper is entirely mathematical. A. W. L.

1677. *Changes in the Length of the Day.* **E. W. Brown.** (Nature, 119. pp. 200–202, Feb. 5, 1927.)—The observations of the moon and of occultations which seem to indicate a change in the length of the day are reviewed. The coincidence of solar and lunar fluctuations seems to establish the origin of these fluctuations in changes in the length of the day. The cause of the changes must be internal and, if due to a radial expansion and contraction of the earth, will be given by a radial variation of about 5 in. if the whole mass of the earth is involved, or of 12 ft. if a crust 50 miles thick only is concerned. If oscillations of the crust occur, it might be possible to correlate their effect on the length of the day with periods of seismic activity. Records are hardly adequate for this to be done, though an apparently satisfactory correlation has been established between the frequency of British earthquakes and the differences between the Greenwich observations and the occultations. A. Wh.

1678. *Figures of Equilibrium, the Stratification of the Planets and the Equation of the First Kind.* **R. Wavre.** (Comptes Rendus, 184. pp. 373–375, Feb. 14, 1927.)—Deduces equations for the equilibrium of masses of homogeneous fluid at rest and in rotation, and deals with the stratification of a heterogeneous fluid mass regarded as a superposition of homogeneous fluids bounded on each side by surfaces S_t, using an extension of a method employed by Hamy. Introduces parameters representing the surface S_t, and obtains one equation (with surfaces of revolution) or two equations, which are Fredholm equations of the first kind if the stratification is considered as given. In the general case ω the angular velocity is variable, depending on the distance from the axis of rotation, and there is a single Fredholm equation. H. N. A.

1679. *The Variable Star Rz Eridani.* **J. Gadomski.** (Acad. Polonaise, Sci. et Lettres, Bull. 8a. pp. 303–312, Oct., 1926. In French.)—This star was discovered to be an eclipsing variable of Algol type by Miss

Mackie at Harvard in 1916, and a period of 19·64 days was deduced from the photographs. In 1923 observations were begun in Poland, and later in Germany and in Switzerland. These observations are here summarised, and it is shown that the correct period is 39·293 days, *i.e.*, twice as long as was thought at Harvard. The magnitude varies from 7·81 to 9·05. A diagram of the light-curve and a table of comparison stars are given.

M. A. E.

1680. *Provisional Elements and Dimensions of S Antliæ Considered as an Eclipsing Binary.* **A. H. Joy.** (Mt. Wilson Observat. Contrib. No. 322. Astrophys. J. 64. pp. 287–294, Dec., 1926.)—The spectrum is similar to that of W Ursæ Majoris in that it shows wide double lines, but the type for both components is estimated to be A8. Luizet's double period, 0.64833872 day, fits the observations. Nineteen spectrograms, obtained with a single prism, serve to determine the elements of the orbit: $e = 0\cdot0$ (assumed); $\gamma = -5\cdot0$ km./sec.; $K_1 = 81$ km./sec.; $K_2 = 148$ km./sec. The Harvard photometric observations have been used to determine a light-curve and an orbit, the star being considered as an eclipsing variable. The results indicate that the components are very close together and greatly elongated. The eclipse is partial. $a_0 = 0\cdot36$; $k = 0\cdot77$; $i = 62° 10'$. Judged from their spectra, the light of the brighter star is twice that of the fainter. The spectrographic and photometric observations are combined to give the dimensions of the stars and the system: radius of relative orbit = 2,300,000 km.; semi-major axis of large star = 1,160,000 km.; semi-major axis of small star = 896,000 km.; distance of surfaces = 251,000 km.; $m_1 = 0\cdot75$ ⊙; $m_2 = 0\cdot42$ ⊙; $\rho_1 = 0\cdot31$ ⊙; $\rho_2 = 0\cdot38$ ⊙.

AUTHOR.

1681. *Absolute Dimensions of O-Type Eclipsing Variable, H.D. 1337.* **J. A. Pearce.** (Dominion Astrophys. Obs. Victoria, Publ. 3. No. 13. pp. 275–306, 1926.)—The paper is in three parts: I. The Spectroscopic orbit. The spectrum is found to be of type 0·8·5*n*. The author attributes the calcium cloud to one of wide interstellar distribution. II. The photometric orbit. Adams' revised period of $3^d\cdot52341 \pm 0^d\cdot00003$ satisfies both photometric and spectroscopic observations. Guthnick's photometric curve is precise, and shows that components are elliptical with their long axes joining their centres; that eclipses are partial, with inclination differing a little from 90°; that orbit is eccentric; that there is a periastron effect; that both bodies have some surface brightness. Three solutions of the orbit are given. III. The physical characteristics. Constants and derived elements are given, also absolute masses and dimensions. Mass of binary system is exceeded only by the spectroscopic binaries B.D. 6°·1309 and 29 C.Ma., but by no other *eclipsing* binary. The author confirms Plaskett's conclusion that the average O-type star is about 5 times the B-type and 40–50 times the sun; he gives a table of mass data for O, B0, B1, and B2 binaries. The most important point is the determination of O-type density; the components of H.D. 1337 are 0·003 and 0·009 times the sun's density, showing that there is nearly 100-fold dispersion in these high-temperature stars. Comparing with γ Cygni, this might be called a dwarf binary and H.D. 1337 a giant. Eddington's mass-luminosity law gives too small a magnitude for these massive, high-temperature and tenuous stars. H.D. 1337 and B.D. 6°·1309 are about 3200 parsecs distant and beyond Wilson's ring of O-type stars; if the period of H.D. 1337 were four times as long, these two systems would be practically identical in all respects. A. S. D. M.

1682. *Orbits of Two Spectroscopic Binaries.* **W. H. Christie.** (Dominion Astrophys. Obs. Victoria, Publ. 3. No. 14. pp. 307–314, 1926.) —Thirty-five spectrograms of the star H.R. 6506 (H.D. 158261) form the basis of the determination of the orbit of this spectroscopic binary. As determined from the spectrograms taken by the author the type is A2, although given in the H.R. and H.D. catalogues as B9. The spectrum is characterised by sharp lines suitable for accurate measurement. The period, determined graphically, is 5·9182 days, the eccentricity is 0·031. The probable error of a single plate is ± 1·5 km. per sec. The orbital elements of the spectroscopic binary H.R. 5752 have been determined from measures of forty-one single-prism spectrograms. The period is 1·0085 days, $e = 0 \cdot 00$, and $K = 11 \cdot 37$ km., with a probable error of a normal place of weight unity of ± 0·52 km. per sec. AUTHOR.

1683. *Extra Galactic Nebulæ.* **E. Hubble.** (Mt. Wilson Observat. Contrib. No. 324. Astrophys. J. 64. pp. 321–369, Dec., 1926.)—These nebulæ are classified under Irregular and Regular (subsections Elliptical and Normal or Barred Spirals, whose individual members in each class differ only in apparent size and luminosity). About 97 % show rotational symmetry about dominating non-stellar nuclei. The various forms are described. A statistical study is based on Hardcastle's northern stars (down to 13th photographic magnitude), Holetschek's stars north of − 10° Dec. (down to 12·5 visual magnitude), and Hopmann's photometric measures of comparison stars, from which are obtained diameters, types and visual magnitudes of 400 nebulæ. A linear correlation is found between total magnitudes and logs of diameters expressed in the form $m_T = C - K \log d$, where K is constant from type to type and approximates to 5·0, indicating that the surface brightness is constant for each separate type. The variations in C indicate a progressive diminution in surface brightness from class to class throughout the sequence, which represents different phases of a single fundamental type of astronomical body. There is no appreciable absorption, general or selective. Elliptical nebulæ conform to the shapes of a globular mass expanding equatorially, their minor diameters depending on the total luminosities. The scale of types becomes the time scale in the nebular evolutionary history; $m_n - m_T$ is found constant; the total luminosity is about four times that of the nucleus. Tables are given of the absolute magnitudes of eight nebulæ and of their brightest stars, and for thirty-two objects of the differences between their magnitudes and of their brightest stars, from which it is inferred that for nebulæ $\overline{M} = -15 \cdot 3$. The author gives $\log D = 0 \cdot 2\, m_T + 4 \cdot 04$ for distance in parsecs; $2 \cdot 6 \times 10^8 \odot$ as the mean nebular mass; one nebula per 10^{17} cubic parsecs, or $1 \cdot 5 \times 10^{-31}$ in c.g.s. units, as the density of space (which is approximately uniform); and $2 \cdot 7 \times 10^{10}$ parsecs as the corresponding radius of curvature of the finite universe of general relativity. A. S. D. M.

1684. *Genesis of Great Nebulæ.* **J. H. Jeans.** (Nature, 119. pp. 315–316, Feb. 26, 1927.)—Hubble estimates that if the matter of the nebulæ were uniformly spread through space it would form a medium of density $1 \cdot 5 \times 10^{-31}$ [see preceding Abstract]. The author refers back to his work in 1901 on the " gravitational instability " of a uniform tenuous gas, and to his " Problems of Cosmogony " in 1917, in order to trace out one step farther the evolution of the universe by a scheme which covers five complete generations of astronomical bodies having masses of the order of 10^{48} (or more), 10^{42}, 10^{34}, 10^{29}, 10^{25} gm. respectively, the birth of each generation from the preceding generation being through the agency of " gravitational instability." A. S. D. M.

1685. *Anagalactic Nebulæ.* **K. Lundmark.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 9. pp. 1–6, 1926. In English.)—The three subgroups of anagalactic (*i.e.*, extra-galactic) nebulæ [see Abstract 591 (1927)] differ in radial velocity, the Elliptical moving with the highest speed, the Spirals with less, and the Magellanic-Cloud-type with the least. They seem to differ also in dimensions, the real diameters, found by various methods, being on an average ten times as great in the Spirals as in the Elliptical ; and this agrees with Jeans' theory that the Elliptical are a younger type. The Magellanic-Cloud-type are also smaller, but only because the spiral structure has more or less broken down and only the central part remains bright. A large number of double and multiple nebulæ exists, and a preliminary catalogue of 60 has been made. The components of these, and also of the " nests " or clusters which contain from 100 to 1500 nebulæ, are probably physically connected, and as this implies an equal distance from us, a study of the form and type, etc., of each will be of great value. Taking the distance of the Andromeda Nebula as 1,400,000 light-years, the nest of nebulæ at the pole of the Galaxy should be distant 800 millions of light-years. M. A. E.

1686. *Radiative Equilibrium in the Outer Layer of Stars.* **V. A. Ambarzumian** and **N. A. Kosirev.** (Roy. Astron. Soc., M.N. 87. pp. 209–215, Jan., 1927.)—Milne has derived an equation

$$2C'(\tau) = \int_0^\tau \frac{C(\tau + y) - c(\tau - y)}{y} \cdot e^{-y} \cdot dy + \int_\tau^\infty \frac{C(\tau + y)}{y} \cdot e^{-y} \cdot dy,$$

and has deduced an approximate solution

$$C'(\tau) = B(\tau) = a + 2b\tau + \tfrac{1}{2}e^{-\tau}(b - a - b\tau) + \tfrac{1}{2}(a\tau + b\tau^2)\int_\tau^\infty \frac{e^{-y}}{y} \cdot dy.$$

It is shown that the equation has one solution only : $C'(\tau) \equiv B(\tau) \equiv 0$. Hence radiative equilibrium without the generation of energy becomes impossible for finite intensities of radiation. The paper deals solely with the mathematical reduction of the equations. A. Wh.

1687. *Relation of Colour and Apparent Magnitude in Some Low Galactic Latitude Regions.* **E. A. Kreiken.** (Roy. Astron. Soc., M.N. 87. pp. 196–207, Jan., 1927.)—Seares has shown [see Abstract 1609 (1925)] that his formula, $I_c = -0{\cdot}16 - 0{\cdot}050m_{ph}$, gives larger colour indices than those obtained for faint Milky-Way stars by the author, who discusses in the present paper eleven regions for which the final mean values of the colour index are given by $I_\lambda = A + Bm_{ph}$. He compiles the results in two tables and a diagram in which the colour index values are plotted against magnitude. For the fainter stars in the Pleiades Cluster the colour magnitude relation is shown not to be a linear one. In the Scutum-Aquila region colour increases rapidly with magnitude and probably does not show a linear relation for still fainter stars. Shapley's curve for galactic stars near M_{11} is not in keeping with the others. Seares' mean curve gives for all magnitudes too large a colour index for these low galactic regions. Nearly all the curves have a definite tendency to converge towards one point (about $m = 16 \cdot 5$ and $I_\lambda = + 0 \cdot 60$). He discusses the frequency of different colour indices, and from the formula $L(m) = e^{a + bm - cm^2 - 0 \cdot 4m} dm$ computes the mean colour of the sky and gives a table for certain regions. Fath has found an "approximately solar type" for the Scutum region, but the author's value for this region is less advanced. A. S. D. M.

1688. *Dense Matter.* **R. H. Fowler.** (Roy. Astron. Soc., M.N. 87, pp. 114–122, Dec., 1926.)—Eddington has pointed out an apparent difficulty in the theory of the equilibrium of the very dense material forming the bulk of certain stars. This dense matter consists of electrons and nuclei with such a high energy that all ordinary structures are unstable and the aggregate can be treated as a perfect gas subject to certain modifications due to the electrostatic forces. Such material will be at a very high temperature and consequently will radiate rapidly. Apparently it will radiate until its total energy will be lower than that of the expanded material at the absolute zero. This paradox is shown to be based on the relation between energy and temperature suggested by classical statistical mechanics which is not applicable to this case. Fermi and Dirac have developed a theory which is applied to this problem, and it is shown that the temperature and hence the radiation will fall to zero while the energy is still sufficient to allow adiabatic expansion of the material. The star when it has ceased radiating is comparable to an enormous molecule in its lowest quantum state. A. Wh.

1689. *Stellar Ionisation.* **Cecilia H. Payne.** (Nat. Acad. Sci., Proc. 12. pp. 717–722, Dec., 1926.)—Changes in the partial electron pressure alter the ionisation conditions in a star, and in this paper is outlined a graphical method of taking this variation into account. The different forms of the ionisation curve are reproduced, and the change in number of effective atoms can be read either for constant pressure or constant temperature. If the intensity ratio for a spectrum line in two stars is known and their temperatures, it is possible to determine the ratio of partial electron pressures. A. Wh.

1690. *Spectra and Ionisation of Class c F8 Stars.* **Cecilia H. Payne.** (Nat. Acad. Sci., Proc. 12. pp. 722–728, Dec., 1926.)—The methods outlined in another paper [see preceding Abstract] are applied to the elucidation of details of the spectra of c-stars. If the relative intensities of lines due to two states of an atom in any star are known, it should be possible to calculate the partial electron pressure. To check the reliability of the method it is applied to certain figures for the sun taken from Rowland's table. The general agreement with accepted facts is good, and the procedure is then applied to γ Cygni. A. Wh.

1691. *Scintillation of Stars.* **G. Rossi.** (Accad. Lincei, Atti, 5. pp. 565–568, Dec., 1926.)—An historical review of the subject, to be followed by a paper giving an account of researches carried out at the Campidoglio Observatory, Rome, in 1925. E. F.

1692. *Twinkling of Stars.* **A. Danjon.** (Comptes Rendus, 183. pp. 1032–1034, Nov. 29, 1926.)—A differential method of observation described. The fringes observed are swayed by the wind. The path-differences introduced by the heterogeneity of the atmosphere are independent of one another; hence large telescopes can be used. The angular fluctuations of the wave-front rarely exceed $1''$. When this is small the fringes are distinct; and then the maximum path difference between the centre and the periphery in a 16-cm. telescope is $\frac{1}{4}\lambda$, so that Rayleigh's law is observed, and a 16-cm. instrument is sufficiently large for definition. A. D.

1693. *Corrections to Boss System of Declinations in Order of Right Ascension.* **H. Raymond.** (Astron. J. 37. No. 875. pp. 88–90, Jan. 6, 1927.)—The declinations of Boss's *Preliminary General Catalogue* require corrections when compared with recent observations which are negative in the first R.A. quadrant and positive in the third. These come chiefly from errors in the constants of apparent place reduction, from latitude variation, and from refraction. The author analyses these three causes and shows that the correction due to each can be expressed in the form $s \sin \alpha + b \cos \alpha$. He collects the material for solution in a table based on forty-three catalogue authorities, whose data are solved in the form $a = a' + a'' (t - 1900)/100$, and similarly for b. He indicates that the catalogues are more accordant at 0 and 12 hours than at 6 and 18 hours, these last having the extreme temperatures of midwinter and midsummer affecting the observations. The maximum value of $\Delta\delta_a$ or $\Delta\mu_a$ is only one-fourth that of $\Delta\delta_\delta$ or $\Delta\mu_\delta$, given in the author's previous paper. [See Abstract 1779 (1926).] A. S. D. M.

1694. *Spectrophotometric Determinations of the Absolute Magnitudes of B- and A-Type Stars.* **C. Schalén.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 4. pp. 1–35, 1927. In English.)—[See Abstract 1560 (1922).]

1695. *Proper Motion of 318 Faint Stars in Cygnus.* **A. Vyssotsky.** (Astron. J. 37. No. 877. pp. 101–114, Feb. 16, 1927.)—The author took photographs in 1925 with the McCormick 26-in. visual refractor to compare with four Rutherford regions taken 50 years ago in the Milky Way round the Cygnus stars, η, 27, 34 and γ. From these the proper motions of 318 stars are found of which spectral classes and magnitudes are given in the *Henry Draper Catalogue* or *Extension* by which all the McCormick stars were reduced to the Draper Catalogue system; there are also 151 stars with known spectra whose proper motions are given in *Cron. Publ.* 30. The probable errors of these two series of stars are $\pm 0''\cdot 0015$ and $\pm 0''\cdot 0022$ respectively. The peculiar motions of the B-stars in the Cygnus cloud are smaller than the errors of measurement, and their mean motion is very small but differs greatly from the Groningen data though those of Classes A, F, G and K are in good agreement. Diagrams show the effects of Kapteyn's two drifts. A. S. D. M.

LIGHT.

1696. *Distribution of Light Absorption.* **J. Plotnikow.** (Zeits. Wiss. Phot. 24. pp. 305–308, Oct., 1926.)—Reconsiders the problem of the distribution of absorption between different components of a mixture. The accepted views lead to impossible results in particular cases. Proposes a new formula. A. D.

1697. *Transparency of Sea-Water for Radiations in the Extreme Ultra-Violet.* **K. Sukamoto.** (Comptes Rendus, 184. pp. 221–223, Jan. 24, 1927.)—A quartz spectrograph was employed to measure photographically the absorption spectra of samples of sea-water obtained from (1) the surface, (2) a depth of 3 m., and (3) a depth of 15 m. at a place 15 miles from Roscoff. The coefficients of absorption for wave-lengths between 2123 and 2336 Å. are given. Tests made on prepared solutions each with the individual solute contained in sea-water and with the same concentration show that the opacity is due to the dissolved salts. Sea-water is much less transparent than distilled water and especially so for radiations below 2200 Å. where the opacity increases rapidly. This increased opacity at the shortest wave-lengths, the author finds, is due to the salts containing bromine. R. S. R.

1698. *Reflection of a Beam of Rays at a Mirror Moving with Constant Velocity.* **J. Picht.** (Zeits f. Physik, 40. 7. pp. 521–529, 1926.)—A theoretical treatise deducing formulæ for the reflection of light at a moving plane mirror with special reference to the form and reflection of the incident bundles of rays. S. G. B.

1699. *The Alteration of Direction and Plane of Vibration of an Optical Bundle of Rays by Means of a Mirror System.* **J. Picht.** (Zeits. Instrumentenk. 46. pp. 610–614, Dec., 1926.)—A theoretical treatise showing the effect of the reflection of light at several plane surfaces and the alteration of the beam consequent on such reflections. The formula is applied to the construction of instruments for geophysical measurements. S. G. B.

1700. *A Method of Determining the Index of Refraction of Liquids.* **A. Sellerio.** (N. Cimento, 3. 8. pp. 390–404, Dec., 1926.)—A method is here described in which the usual hollow prism is abandoned and an arrangement used with a special prism having an absolutely invariable angle. The operation of measuring is also made easier. The paper is illustrated with diagrams showing the methods employed, and there is an appendix to the paper in which the various compound lenses which form an integral part of the method are fully discussed. A. E. G.

1701. *Measurement of the Index of Refraction of Gases at Higher Temperatures.* **E. W. Cheney.** (Phys. Rev. 29. pp. 292–298, Feb., 1927.)—For light of the visible spectrum the thermal coefficients of the indices of refraction of air, N_2, SO_2, NH_3 and CO_2, were not found to differ from the thermal coefficients of density change in the range 0–300° C. At 0° C. 760 mm., the values of $(n-1)\ 10^7$ for λ5852 Å., 6143 Å., and 6678 Å., were found to be

λ.	Air.	N_2.	NH_3.	CO_2.	SO_2.
5852 Å.	2925	2985	3795	4485	6637
6143 Å.	2919	2977	3785	4473	6615
6678 Å.	2912	2969	3771	4465	6598

Incidentally the rate of expansion of quartz with temperature was found to be constant within the temperature interval 25–300° C., and to have an average value of the expansion coefficient of $0 \cdot 946(10)^{-6}$. A kilowatt neon Geissler tube is described. [See also Abstract 987 (1926).] AUTHOR.

1702. *Glare and Visibility.* **L. L. Holladay.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 1–15, Jan., 1927.)—A continuation of previous work on the subject. [See Abstract 1798 (1926).] Measurements were made of the minimum brightness difference just perceptible in the presence of a glare spot of varying brightness and angular distance from the test object. The variation of this quantity with field brightness was first determined with no dazzle source present. The measurements with the dazzle source present showed that the effect of this source was to raise the field brightness by the amount $2 \cdot 9\ E/D^2$, where E was the illumination at the observers' eye (in metre-candles) due to the dazzle source and D was the angle of elevation of this source (in degrees) above the line of vision. In other words, the difference of brightness just perceptible with a field brightness F in the presence of the dazzle source, was equal to that just perceptible with a field brightness $F + 2 \cdot 9E/D^2$ and no dazzle source.

The second part of the paper is devoted to a consideration of the effect of increasing the candle-power of a source which not only provides the brightness of the field of view but at the same time causes glare by its presence in the field of view. J. W. T. W.

1703. *Theory of Flickers.* **P. Lasareff.** (Phil. Mag. 2. pp. 1170–1187, Dec., 1926.)—A theoretical paper dealing with the author's theory of ionic stimulation in which the relation between the formulae of Allen and of Lasareff is investigated. It is not yet possible to decide whether the generalised formula of Allen or the third formula of Lasareff is in better agreement with experiment, but further investigation is promised.

W. H. GE.

1704. *Use of the Brace Half-Shade Compensator for Simultaneous Measurement of the Azimuth and Ellipticity of an Oscillation Ellipse.* **G. Szivessy.** (Zeits. Instrumentenk. 47. pp. 148–154, March, 1927.)—§ 1 of the paper gives a general description and discussion of the Brace half-shade compensator; §§ 2 and 3 deal with the determination of the azimuth and ellipticity respectively; § 4 includes a detailed account of an instrument made by Schmidt and Haensch of Berlin; and § 5 discusses the method of measurement and accuracy of the instrument. H. H. Ho.

1705. *A Photographic Spectro-Polarimeter for Ultra-Violet Light.* **R. Descamps.** (Rev. d'Optique, 5. pp. 481–501, Dec., 1926.)—In the apparatus described the light from a mercury vapour lamp is concentrated by a quartz or fluorspar lens on an adjustable slit. From there a parallel beam of light, obtained by using a triple achromatic lens of quartz and fluorspar, passes through an analyser of Iceland spar and a glass bath to contain the substances tested. By means of two prisms a deviation of 90° is obtained for the mean of the wave-lengths used. A further achromatic triple lens concentrates the radiations upon a sensitive plate. With an optical substance between the analyser and the polariser extinction occurs at a different place depending also upon the wave-length of the radiation. By microphotometric measurements on the plates the rotation for different wave-lengths is found and the rotatory dispersion calculated. The method of successive approximations was abandoned to obtain greater speed of working, but some loss of accuracy occurred. The range of wave-lengths used was between 4358 and 2536 Å., and an accuracy of 1/200 could be obtained for the rotatory dispersion. Precautions were taken to eliminate scattered light. A preliminary examination of the negative gives a qualitative idea of the dispersion and saves considerable time. R. S. R.

1706. *Quartz Standards. Measurements of Length and Refractive Index.* **A. Pérard.** (Comptes Rendus, 184. pp. 84–87, Jan. 10, 1927.)—Results are given of measurements of the length of a series of quartz standards with edges 10, 20, 30, 40, 50 and 100 mm. Determinations were made at temperatures ranging from 5° C. to 25° C., and the lengths are believed to be accurate to within 0·02 μ. For details of the method of comparison see a former paper [Abstract 2076 (1922)]. Values are also given of the refractive index for the ordinary ray, and the dependence of the refractive index upon wave-length is discussed. A. W. L.

1707. *A Compound Interferometer for Fine Structure Work.* **W. V. Houston.** (Phys. Rev. 29. pp. 475–484, March, 1927.)—The overlapping of orders in a Fabry-Perot interferometer can be avoided by using two interferometers in series. The fundamental equation shows that the dispersion is independent of the plate separation, while the distance between orders is inversely proportional to it. Thus an instrument with a small separation may be used as a preliminary filter to eliminate some of the orders in one of larger separation. This will not affect the fine structure pattern, and the resolution will be even greater than that due to the larger separation. Such an instrument has been built and satisfies the predictions of the theory. A plate, taken with the green line of mercury, is shown to illustrate the effect of the preliminary interferometer. AUTHOR.

1708. *Thickness of the Optical Transition Layer in Liquid Surfaces.* **C. V. Raman** and **L. A. Ramdas.** (Phil. Mag. 3. pp. 220–223, Jan., 1927.)—The coefficient of ellipticity, K, for light reflected from a number of liquid surfaces at the Brewsterian angle has been measured and the results are given in a table. There is no marked correlation between the refractive index and this coefficient, and it is unlikely that the observed ellipticity is due to a film absorbed on the surface from the atmosphere, the suggestion that it depends on orientation of the surface molecules is also ruled out, and the authors consider that the effect is due to a diminution in density of the surface layer resulting from molecular movement [see Abstract 286 (1926)]. One column of a table gives the minimum thickness *t* of the transition layer at room-temperature for different liquids, calculated on the assumption that the refractive index of the transition layer is the square root of that of the rest of the liquid. This thickness for the pure liquid surfaces is of the same order as the molecular diameter determined by viscosity measurements. The thickness of films of oleic and palmitic acids on water surfaces were shown by the observations of ellipticity to be monomolecular. H. N. A.

1709. *Theory of Surface Layers.* **J. T. Groosmuller.** (Phys. Zeits. 28. pp. 88–89, Jan. 15, 1927.)—A mathematical analysis of other treatises on this subject, in the course of which the author shows that Drude's theory, rightly interpreted, leads to identical results. [See Abstract 2816 (1926).] E. F.

1710. *An Exact Graphical Determination of the Minimum of Prismatic Dispersion.* **A. Seiffert.** (Zeits. Instrumentenk. 47. pp. 86–96, Feb., 1927.)—The author states the usual equations which hold for refraction through a prism, and tables are prepared to determine the angles of incidence and refraction at the second refracting surface for given values of the angles of incidence and refraction at the first surface, and for various angles of the prism. A series of curves illustrates the dispersion produced by white light and gives further the maximum and minimum values as a function of the angle of incidence on a prism of Guinand flint glass. Numerical examples are given of the use of the method, and the results obtained are compared with those of Opitz and Erfle. R. S. R.

1711. *Visual Performance of a Telescope.* **A. Kühl.** (Zeits. Instrumentenk. 47. pp. 75–86, Feb., 1927. Zeits. techn. Physik, 7. 12. pp. 636–640; Disc., 640, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The paper is concerned with the measurement of the performance of telescopes which give equally good images, consideration being given to the size of the aperture, the magnification and the loss of light through the system of lenses. The connection between the sharpness of the image and the intensity of illumination is shown by a table, and also graphically. Equations are established which give the complete change of the acuteness of vision when the initial intensity of illumination of the retina is altered only by change of the size of the pupil of the eye. These results are then extended to the case of a telescope which may have different factors of transmission and different contrast factors. Tables and a series of curves show the connection between the performance of a telescope and its magnification. Finally, the results are applied to a pair of Porro prismatic field-glasses and a Galilean telescope. R. S. R.

1712. *Smoke Box for Demonstrating the Laws of Optics.* **W. O. Clarke.** (Journ. Sci. Instruments, 4. pp. 112–115, Jan., 1927.)—By means of the box and its equipment, the greater part of an elementary course on light can be demonstrated to a class of 20–40. The source is an arc light, and the smoke cloud persists for one to two hours. G. E. A.

1713. *Aberration and the Relativity Theory.* **G. Wataghin.** (Accad. Lincei, Atti, 4. pp. 291–296, Oct., 1926.)—Einstein's relativistic formula for the aberration of a plane wave holds good for a spherical wave-front. To the first order the theory of aberration can be developed with the single hypothesis that the light travels in straight lines with reference to any inertial system. Particular aspects of the theory illustrated. A. D.

1714. *Addition of Primary Aberrations.* **G. C. Steward.** (Cambridge Phil. Soc., Proc. 23. pp. 584–587, Jan., 1927.)—A purely theoretical paper giving a simple derivation of the necessary relations between a composite system and its components where first order aberrations only are considered. W. H. Ge.

1715. *Constant of Magnetic Birefringence of Benzene.* **C. V. Raman** and **K. S. Krishnan.** (Comptes Rendus, 184. pp. 449–451, Feb. 21, 1927.)—The authors had already combined the results of optical anisotropy, derived from measurements on optical diffusion, with values of the Cotton-Mouton constant in order to determine the degree of magnetic anisotropy of the molecules. In the present paper by simple suppositions on the structure of benzene and the known optical anisotropy, the Cotton-Mouton constant is evaluated directly and compared with the observed value. A structure suggested by Pauling is adopted. By supposing that all the orbits carbon-carbon are in the plane of the benzene hexagon and the orbits carbon-hydrogen are in a plane perpendicular to the hexagon, the Cotton-Mouton constant as calculated agrees well with the observed value. R. S. R.

1716. *Dispersion of Light in Gaseous Bodies within the Ultra-Violet Spectrum.* **S. Friberg.** (Zeits. f. Physik, 41. 4–5. pp. 378–384, 1927.)—In continuation of the work of Koch [Abstract 1782 (1924)] and Quarder [Abstract 2033 (1924)], measurements are given of the dispersion in the ultra-violet part of the spectrum for methane and ammonia. For methane the values obtained at 21·6° for the refractions differ by more than the possible experimental errors from those calculated by means of Cauchy's dispersion formula, but are in good accord with the four-constant formula

$$\frac{1}{y}=\frac{505625\cdot 10^{-8}}{63\cdot 4355-10^{-8}\lambda^{-2}}+\frac{6147469\cdot 10^{-8}}{175\cdot 1812-10^{-8}\lambda^{-2}}.$$

For ammonia at 20° they agree well with the formula

$$\frac{1}{y}=\frac{86560\cdot 10^{-8}}{25\cdot 8837-10^{-8}\lambda^{-2}}+\frac{4424138\cdot 10^{-8}}{131\cdot 2110-10^{-8}\lambda^{-2}}.$$

The central point of the absorption region is at about $\lambda = 1965$ Å. T. H. P.

1717. *Magnetic Rotary Dispersion of Water, Alcohol, and Alcohol-Water Mixtures.* **D. J. Stephens** and **E. J. Evans.** (Phil. Mag. 3. pp. 546–565, March, 1927.)—The magnetic rotation of water can be expressed over the range from 0·5997 to 0·2428 μ by the equation $\phi = n\delta\lambda^2 = K_1\left(\frac{\lambda^2}{\lambda^2-\lambda_1^2}\right)^2$. The values deduced for λ_1 are steady at 0·1192 μ whichever pair of wavelengths is used in deducing K_1 and λ_1. It therefore appears that an absorption at 1192 Å.U. is the only one that affects the magnetic rotation, no second term being necessary in the above equation. The value of K_1 is 1·61567. The corresponding values for ethyl alcohol are $K_1 = 1\cdot 441$,

$\gamma_1 = 0 \cdot 1114$, the one dominant absorption-band being at a slightly shorter wave-length than in the case of water. In mixtures of alcohol and water, the value of Verdet's constant for wave-lengths $0 \cdot 2753\ \mu$ and $0 \cdot 3363\ \mu$ at first diminishes with increasing percentage of alcohol, then remains almost constant over the range from 30 to 70 % alcohol and finally decreases to the limiting value for pure alcohol. T. M. L.

1718. *Polarisation of Mercury Lines emitted from a Discharge-Tube in a Magnetic Field.* **H. W. B. Skinner.** (Cambridge Phil. Soc., Proc. 23. pp. 508–515, Jan., 1927.)—Theory indicates that the total light from atoms in a magnetic field should be unpolarised—that is, the intensity of the light polarised in one direction should be equal to that in the perpendicular direction. Some experiments appear to contradict the theory, but it seemed probable that the observed polarisation was due to the fact that the source of light was not ideally simple, and the atoms emitting the light were not subject to isotropic conditions of excitation. The author has employed a low-pressure electron-maintained, mercury arc, in which the low pressure may be expected to remove a number of disturbing conditions and the current can be varied. Two distinct polarisation effects have been observed; with λ5770 and λ5791 the effect is destroyed by a strong magnetic field, and it is due to anisotropic excitation, for it depends on the directed character of the discharge. The effect with λ5461 is a complex one, whose magnitude depends on the conditions of the discharge, vanishing to zero when the current is reduced; this effect is only observed in a strong field. It is suggested that the effect is due to self-reversal of λ5461 owing to the instability of the 2^3P_2 state, and that the polarisation may be caused through a slight non-uniformity of the magnetic field. The line λ4358 is unpolarised under all conditions tried. The theory is confirmed by the experiments. H. N. A.

1719. *Interference Peculiarities of Light emitted by Canal Rays.* **A. Einstein.** (Preuss. Akad. Wiss. Berlin, Ber. 25–26. pp. 334–340, 1926.)—In this paper the following three cases are considered: (1) When nothing which bends the rays of light is included between the canal rays and the interference apparatus. (2) When a lens or lens system of focal length f is included between the canal rays and the interference apparatus. (3) When a slit or grating is included between the canal rays and the inteference apparatus. It is concluded that if the statement of the irregularity of the influence of parallel displacement of the source of light on the interference appearances of the extended sources of light is correct, then the observed interference appearances in homogeneous canal rays must be in accord with the classical emission theory of light, that is, as if the canal ray particles are moving Hertzian oscillators. An influence of the quantum structure of the rays is not to be expected. [See next Abstract.] A. E. G.

1720. *Interference Peculiarities of Light emitted by Canal Rays.* **E. Rupp.** (Preuss. Akad. Wiss. Berlin, Ber. 25–26. pp. 341–351, 1926.)—In this paper two interference experiments on canal rays are described. These were undertaken as a consequence of the theoretical investigation on the subject by Einstein [see preceding Abstract.] The results of both experiments are deductions from the undulatory theory. [See also Abstract 1436 (1926).] A. E. G.

1721. *Coherence and Consonance of Light.* **M. Berek.** (Zeits. f. Physik, 40. 6. pp. 430–450, 1926.)—Continuation of previous work [see Abstracts 1807 and 2340 (1926).] An array of practical problems considered. A. D.

1722. *Electric Double Refraction of Colloidal Benzopurpurin.* **T. Wereide.** (Zeits. f. Physik, 41. 11–12. pp. 857–863, 1927.)—When solutions of benzopurpurin are diluted with water, the electrical double refraction changes more slowly than the concentration, but approximately in the same way as the electrical conductivity. Increase in the ionic concentration of the solution, especially by addition of hydrochloric or sulphuric acid, results in a pronounced diminution of the double refraction when the conductivity increases about five-fold. T. H. P.

1723. *Scattering and Polarisation of Light by Dispersed Carbon.* **G. I. Pokrowski.** (Zeits. f. Physik, 40. 3–4. pp. 278–282, 1926.)—Experimental results with dispersed carbon (in flames, in water-suspension, and on diffuse reflection from soot-films). Comparison of these results with the theory. A. D.

1724. *Results of Observations on the Scattering of Light in Suspensions.* **G. I. Pokrowski.** (Zeits. f. Physik, 41. 6–7. pp. 493–506, 1927.)—The results of observations on the scattering and polarisation of light in suspensions of coarse particles (approximating to the wave-length of light) are collated and compared with theory. It is shown that with the suspensions examined the scattering agrees only qualitatively with the dispersion on elementary spheres, and that a considerable admixture of unpolarised light is to be observed. The paper consists mainly of figures and curves. [See Abstracts 2066, 2070 (1926) and preceding Abstract.] E. F.

1725. *Chemical Actions of Radiations.* **P. Villard.** (Comptes Rendus, 184. pp. 131–134, Jan. 17, 1927.)—Belliot's results [Abstract 2590 (1926)] largely confirm and complete the author's observations [Abstract 1499 (1907)]. The destruction of a latent image must be distinguished from solarisation, with which it is usually confused. In a photographic plate fogged by X-rays of ordinary hardness, the deep levels of the silver and bromine atoms (*e.g.*, the K levels) have been reached, effecting a rupture of the equilibrium which constitutes the latent image. The action of ordinary light will now cause electronic agitation in the optical levels and will immediately render possible the reconstitution of the far more stable K levels, so that the impression produced by the X-rays will have disappeared, and the sensitiveness to these rays restored. All radiations of the visible spectrum are efficacious to an extent depending on their quanta. The continuation effect in which the action commenced by violet rays is carried on by red rays was first observed by Becquerel and is easily realised with papers sensitive to direct blackening and containing silver nitrate, addition of a little tartaric acid being of advantage. Tartaric acid alone is not capable of developing an exposed paper, but is rendered so with the help of a radiation with a quantum which is as high as possible without having an appreciable effect on the paper. T. H. P.

1726. *Chemical Actions of Radiations.* **A. G. de Moncetz.** (Comptes Rendus, 184. pp. 284–285, Jan. 31, 1927.)—In view of the recent publications by Belliot [see Abstracts 2590 and 2591 (1926)] and Villard [see preceding Abstract] the author summarises the results described in his earlier papers [Abstracts 1257 (1908) and 638 (1909)]. T. H. P.

1727. *Chemical Action of Radiations. Remarks on de Moncetz's Recent Note.* **P. Villard.** (Comptes Rendus, 184. pp. 309–312, Feb. 7, 1927.)—De Moncetz [see preceding Abstract] observed that the action of infra-red rays with λ between 9200 and 13,500 Å. on a photographic plate fogged by X-rays results in the intensification of the fog. Similar effects often occur in spectrographic experiments and it appears that some of the extreme violet and ultra-violet light diffuses into the spectrograph to diminish the fog, whereas the destructive influence of the spectral radiations, diminishing regularly towards the infra-red, comes into play at that part of the plate on to which the spectrum is projected. When this action exceeds a certain value, the effacement of the fog proceeds almost normally, but below this value, with a lower quantum, the infra-red is able only to counterbalance the influence of the diffused ultra-violet, thus giving rise to a simple protection effect. Thus, there is no intensification of the fog by light of 9200–13,500 Å., but only retardation of the dispersion of the fog by the diffused rays. T. H. P.

1728. *Chemical Actions of Radiations.* **P. Villard.** (Comptes Rendus, 184. pp. 352–354, Feb. 14, 1927.)—The author's view that two latent images produced, one by ordinary light and the other by X-rays, should have different properties [see preceding Abstracts] may be verified by treating the plates, before development, with either 2–5 % potassium ferricyanide solution containing 0·5–1 % potassium bromide or a 0·1 % mercuric chloride or bromide solution. The two images, which owe their distinctive properties to the fact that they do not correspond with the same atomic levels, may exist together without interference. Experiment shows that the radiograph is negative, whereas a solarised plate can have only a positive photograph, unless the distant minimum of the solarisation curve is surpassed. The error of the ordinary opinion that all radiations produce impressions of the same character on photographic plates is emphasised. T. H. P.

1729. *Sensitisation of Silver Bromide and Silver Iodide by Adsorbed Ions.* **K. Fajans** and **W. Steiner.** (Zeits. phys. Chem. 125. pp. 307–320, Feb., 1927.)—The "spectral" sensitisation of a photographic plate (*i.e.*, is the displacement of the sensibility in the region of long wavelengths, which was discovered by H. W. Vogel) is discussed, together with the other published work on the same and allied problems. The results lead to the conclusion that the "spectral" sensitisation of silver bromide and silver chloride by the ions Ag^+, Tl^+, OH^-, SO_3^{--}, and the ion of phenylpropionic acid, is closely connected with the adsorption of these ions into the space lattice of the silver halides. It is more probable that the primary photochemical process is influenced by these ions rather than a chemical acceptor action on the halogen which is liberated by the light. In the case of Ag^- and Tl^- ions the influence may be due to a deformation action of these cations on the halogen ions at the surface of the space lattice from which the electrons are liberated. F. J. B.

1730. *Contrast of Photographic Printing Paper.* **L. A. Jones.** (Eastman Kodak Co. Research Lab. Comm. No. 264. Frank. Inst., J. 202. pp. 177–204, Aug.; 469–516, Oct.; 589–625, Nov., 1926, and 203. pp. 111–156, Jan., 1927.)—In these four papers the following are the main points considered: The nature of contrast; outline of sensitometric method; outline of statistical method; tone reproduction theory; *résumé* of nomenclature, symbols, etc. Data relative to the object; data relative to the negative material; data relative to negatives and positives. Sensitometric results; effect of development on the characteristic curve of photographic papers; constants determined from the sensitometric curves of the positive materials; determination of colour coefficient. Derivation of contrast from sensitometric and statistical data; isolation of the utilised section of the characteristic curve; determination of the limiting gradient θ; equalisation of limiting gradients; evaluation of the contrast function; graphic method for obtaining contrast values; numerical values of contrast; relation between contrast and density scale; evidence against the use of ϕ for the evaluation of contrast; contrast scales. A. E. G.

1731. *Intensification of the Latent Image on Photographic Plates and Films. I. Experimental Study of Latent Image Intensification.* **E. P. Wightman** and **R. F. Quirk.** (Eastman Kodak Co. Research Lab. Comm. No. 269. Frank. Inst., J. 203. pp. 261–287, Feb., 1927.)—It was shown in some recent work by Wightman, Trivelli and Sheppard [see Abstract 84 (1926)] that when single-layer plates were given a flash exposure to light, and were then treated with a solution of H_2O_2, that there resulted an increased developability greater than the sum of the separate light and peroxide effects. The reason suggested for this was that not only the developable latent image, but also the undevelopable image is produced by light and that the H_2O_2 action carries this over into developable latent image, at the same time making its normal proportion of grains developable. This phenomenon may be called "intensification of latent image." The purpose of the present work is to study the mechanism of latent image intensification and of latent fog production, and to learn, if possible, the relation, if any, of these effects to the action of light on the photographic emulsion. It deals chiefly with an experimental study of the intensifying action of hydrogen peroxide, but the intensifying action of silver nitrate is also briefly considered. A. E. G.

1732. *Photographic Elements and their Applications to Technical Photography.* **T. T. Baker.** (Phot. J. 67. pp. 85–90; Disc., 90–91, Feb., 1927.)—Selenium is dealt with at some length because it has been used, and is likely to be used, on such a large scale in the problems of talking cine-films, of photo-telegraphy and of television, quite apart from its established uses in the field of photometry. It also offers a real hope of providing some system of X-ray sensitometry and actinometry. One important difference between the selenium cell and the photoelectric cell is that, while the current produced by the latter on illumination is more or less strictly proportional to the intensity of the light, the conductivity–illumination curve is only straight over a limited range in the case of selenium. A. E. G.

1733. *Photographic Mapping Methods.* **H. Lüscher.** (Engineering, 123. pp. 63–65, Jan. 21, and pp. 185–189, Feb. 18, 1927.)—In these articles the methods and apparatus used in photographic surveys are explained, and particular reference is made to their development in Germany during the last fifteen years. Starting with plane-tabling photogrammetry the progress is traced through the stereo-comparator in which the principles of stereoscopy were introduced into photogrammetry, the stereoautograph of v. Orel, the Zeiss hand-held aerial survey camera, and the auto-cartograph of Hugershoff, to the Bauersfeld stereoplanigraph, which is believed to be the best device yet produced for plotting air photographs by mechanical means. The paper is fully illustrated, the various apparatus and the kind of photographs obtained being shown. A. E. G.

1734. *Measurement of Resolving Power of Photographic Materials.* **O. Sandvik.** (Eastman Kodak Co. Research Lab. Comm. No. 289. Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 169–177, Feb., 1927.)—The resolving power of a photographic material may be defined qualitatively as the ability to show fine detail in the picture. Many methods of direct measurement and methods which have been suggested by general definitions have been used to establish quantitative values for resolving power. The practice generally among recent workers has been to photograph in a reducing camera some type of test object on the photographic material under consideration. The resolving power is defined as the number of lines per millimetre which are resolved. It has been assumed in some cases that only the periodicity, that is, the distance between the centres of the two lines and not the relative width of the lines to space effects the resolvability of a pair of lines. The present paper gives some results obtained with a parallel line object designed to test the validity of the above assumption. This test object consists of sixteen groups of parallel lines. Each group contains three opaque spaces and two transparent lines. Considerable difficulty is experienced in making test objects sufficiently small that would have the desired quality. A new resolving power camera is now being constructed which will have a reduction of sixty diameters as compared to the one here used of twenty diameters. With this new camera the test objects can therefore be three times as large for equivalent resolving powers. When this camera is completed other phases of the problem will be investigated. A. E. G.

1735. *Capabilities of the Agfa-Colour Plate.* **C. Schaefer** and **K. Ackermann.** (Zeits. techn. Physik, 8. 1. pp. 2–8, and 8. 2. pp. 55–62, 1927.)—The following points are dealt with in the first paper: The law of colour mixing and the characterising of colours through coordinates; the true ground colours; the geometrical exhibition of colours; photography in natural colours; photography of the colour cycles *n c*. In the second paper: The transmission function of the colour grains; the colour tone, saturation and brightness of the photogram as compared with the original; the choice of colour grains. A. E. G.

1736. *Light Distribution Curves by Physical Photometry.* **E. Spiller.** (Zeits. techn. Physik, 8. 1. pp. 15–17, Jan., 1927. From the Reichsanstalt.)—Describes a method of determining the polar curve of a light source by means of a Moll vacuum thermoelement and galvanometer. The light passes through a filter and is concentrated on the element by means of a lens. The agreement with visual measurements is generally satisfactory, the difference seldom exceeding 1 %. J. W. T. W.

1737. *Equi-Brightness Curves on an Illuminated Sphere.* **G. I. Pokrowski.** (Zeits. f. Physik, 41. 8–9. pp. 695–700, 1927.)—Refers to a paper on this subject by A. Hnatek [see Abstract 1348 (1927)] in which it was concluded that of the various expressions which have been proposed for the brightness of a diffusing surface at different angles of view and of incidence of the light, the only one which gives possible results at extreme angles is the simple cosine law. The author proposes a somewhat different relationship which he shows will give possible results in all cases, and he describes experimental work which confirms the theoretical values calculated from his expression. J. W. T. W.

1738. *New Camera for Colour Photography.* **A. B. Crow.** (Phot. J. 67. pp. 132–134; Disc., 134–135, March, 1927.)—In the apparatus described a group of achromatic refracting prisms is arranged symmetrically round the axis of a lens. The pencil of rays is thus divided into two, three or more sections, each passed through a light filter, and then focussed to form a separate image of selected colour. Adjustable stops are used to equalise the exposures required for the different colours. Special adjustments were used to overcome astigmatism and difficulties of focus and register. The several images thus photographically reproduced can then be projected simultaneously in register, and the resulting synthetic projection reproduces the natural colours of the object. Several imperfections of the present form of camera are detailed. R. S. R.

1739. *Illuminator for Use in Metallographic Microscopy.* **L. E. Jewell.** (Eastman Kodak Co. Research Lab. Comm. No. 291. Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 159–167, Feb., 1927.)—The general conditions for oblique and conical illumination are examined for different textures of surfaces. Specular reflection is most useful for metallic specimens, polished and etched to bring out details of structure. A cross-sectional drawing shows the method employed. For conical illumination an improvement on H. S. George's method avoids many of the difficulties he experienced, and gives excellent definition with a field remarkably free from haze due to scattered light. For relief illumination a mirror is inserted into the microscope at 45° with the axis and with its central part cut away. Specular reflection is obtained from polished elements perpendicular to the optical axis and diffuse reflection from unpolished areas or surface irregularities. The outer zone of the objective transmits the former and the inner zone the latter. Thus by using an adjustable diaphragm any required balance between them is possible and relief illumination results. The best mirror surface is one with a very high perfect polish slightly dulled by an extremely fine abrasive. Several reproductions show the results obtained. R. S. R.

1740. *Fluorescence of Sodium Vapour in Circular Polarised Light.* **W. Hanle.** (Zeits. f. Physik, 41. 2–3. pp. 164–183, 1927.)—A study of the fluorescence of sodium vapour excited by circular polarised light; the influence of the vapour pressure, of the presence of argon, neon, helium, hydrogen and nitrogen, and the strength of the magnetic field are investigated. W. H. GE.

1741. *The Fluorescence of Cadmium Vapour.* **W. Kapuściński.** (Zeits. f. Physik, 41. 2–3. pp. 214–220, 1927.)—All precautions were taken to eliminate occluded gases, mercury vapour, etc., in the quartz globe container. Finally the highly evacuated cadmium vapour was radiated by ultra-violet spark light. Besides the resonance lines 2289 Å. and 3261 Å. several other lines of the arc spectrum were also observed (namely, 3613, 3467, 3404, 5086, 4800, 4678, and 3133 Å.). This emission was accomplished by both Cadmium spark excitement and the use of other light sources. It was also established that the lines of other spectra which fall within the region 2300 Å. to 2900 Å. (the ultra-violet fluorescence band) were strongly remitted by cadmium vapour. Full experimental details are given. S. G. B.

1742. *Spectroscopic Tables.* **L. Brüninghaus.** (Tables Annuelles de Constantes et Données Numériques, Paris, 5. pp. 367–718, 1926. Extract.)—The tables included in this collection are those dealing with spectroscopic quantities in the years 1914–1922. They are divided into the following sections—emission spectra (including X-rays, Zeeman and allied effects), structure of line spectra, influence of temperature and pressure upon the constitution of emission spectra, influence of conditions of excitation on the characteristics of line spectra, grouping of lines and bands in series, absorption of gases and vapours of elements and inorganic compounds, absorption of gases or vapours of organic compounds, absorption spectra of inorganic bodies (solids, liquids, and solutions) and of organic bodies. A considerable amount of absorption data is expressed by curves. As references are given throughout, a comprehensive bibliography is included. F. S.

1743. *On Spectral Notation.* **W. M. Hicks.** (Phil. Mag. 3. pp. 614–621, March, 1927.)

1744. *Infra-Red Spectroscopy.* **H. M. Randall.** (Science, 65. pp. 167–173, Feb. 18, 1927.)—A sketch of work in the infra-red region from the time of Herschel to the present day. Particular attention is given to recent work on band spectra, and the lines of future advance are indicated. F. S.

1745. *The Statistics of Light Quanta (Photons).* **L. Brillouin.** (Comptes Rendus, 184. pp. 589–591, March 7, 1927.)—An entirely mathematical paper devoted to the exposition of a statistic method for which the author claims that it places the law of association of light quanta among the fundamental hypotheses. E. F.

1746. *Light Quanta and Interference.* **W. Bothe.** (Zeits. f. Physik, 41. 4–5. pp. 332–344, 1927. From the Reichsanstalt.)—Attempts to decide experimentally between the two following theories: (*a*) the classical properties, namely, energy and impulse, of a certain radiation volume are concentrated in a single quantum, this leads to the conclusions that the quantum moves with a velocity less than that of light, and that it has a finite mass when at rest; (*b*) the second possibility is that a quantum is to be related, not to the whole state of radiation, but to a plane partial wave of this state. In either case it is necessary to ascribe a certain reality to the wave field, which spreads out essentially in the classical manner and in some way acts as a regulator for the position, energy, and impulse vector of the quanta. The experiment consisted of a determination of the hardness of the secondary radiation from a block of paraffin produced by the " primary " radiation sent into it in opposite directions from two other paraffin blocks, on which rays from the same X-ray tube fell. According to theory (*a*) the alteration in the hardness should be less than that due to the Compton effect, while according to (*b*) it should agree with the Compton effect. The result of the experiment, which is described in detail, was to show the correctness of the second theory. Measurements were made both with the whole of the X-rays from the tube and with monochromatic radiation. The paper concludes with an account of the author's theory of the relation between an atom and a quantum in an interference field. He assumes that if the atom is at an electrically dark point, and is not capable of absorbing magnetic energy, it will not be affected by a quantum which flies towards it, while if the atom is at a " bright " point the quantum will be absorbed. Some remarks are made on " matter waves," and it is suggested as possible that the light quanta may have no less reality than the electrons. H. N. A.

1747. *The Statistics of Radiation in a Hollow Space.* **W. Bothe.** (Zeits. f. Physik, 41. 4–5. pp. 345–354, 1927.)—In a previous paper [see preceding Abstract] an account is given by the author of experiments which show the connection between light quanta and plane partial waves, and this connection is in the present paper made use of in the study of the reciprocal action between radiation and matter. The single light quanta are in the present treatment not taken as the independent elements of radiation statistics, but the practically monochromatic and parallel " elementary bundles " of rays, in Laue's sense, with the quanta belonging to them; each bundle may contain a number of quanta varying from 0 to ∞. The absorption of a quantum by an atom from an elementary bundle with s quanta is considered, the atom passing from the energy step W_1 to W_2 ($W_2 - W_1 = h\nu$). The frequency of such processes is taken in accordance with Einstein as proportional to the energy density, and taking account in a similar manner of the passages from state W_2 to W_1 a value of the total energy with periodicity ν is arrived at which is identical with that of Planck's formula. Spontaneous processes are regarded as a special case of the induced ones. The grouping of the quanta is shown to be stationary, this grouping is shown to agree with Bose's statistical results. The energy variations in the radiation are explained in detail in terms of the dualism between waves and light quanta. H. N. A.

1748. *Radiation and Absorption on Schrödinger's Theory.* **J. C. Slater.** (Nat. Acad. Sci., Proc. 13. pp. 7–12, Jan., 1927.)—Radiation and absorption of light by atoms are treated analytically by replacing the atoms by a set of oscillators, as previously described [see Abstract 1834 (1925)]. The analysis is developed on the lines of Schrödinger's wave mechanics [see Abstract 55 (1927)]. A. B. C. L.

1749. *Broadening of Balmer Lines by the Intermolecular Electric Field.* **(Miss) M. Hanot.** (Comptes Rendus, 184. pp. 281–284, Jan. 31, 1927.)—The broadening of the lines of the Balmer series produced by a condensed spark in hydrogen at atmospheric pressure is probably due mostly to the Stark effect of the intermolecular field. This field is produced almost solely by the ions present in the gas and Holtsmark [see Abstract 753 (1919)] has calculated that the width of each line should be proportional to the $\frac{2}{3}$ power of the density (n) of the ions. It may be assumed that the mobility of the ions remains constant, even if the temperature is not the same for different sparks, since the heating is sufficiently sudden to be produced under constant volume. Hence n is proportional to the current density $i = 4\,I_0/\pi d^2$, where I_0 is the total maximum intensity of the current traversing the spark and d the diameter of the spark. Determinations of d by photographing the sparks on a moving plate give irregular results in the case of hydrogen, but in air the sparks exhibit a brilliant central region which certainly transmits the major part of the current. The diameters of this central region doubtless vary as regards absolute values with different gases, but their variations with I_0 probably follow similar laws. On these assumptions the results obtained with sparks in air are as nearly in agreement with Holtsmark's calculation as can be expected. T. H. P.

1750. *Physical Optics. Report of Progress Committee for 1925–26.* (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 103–124, Feb., 1927.)—A review.

1751. *The Unity of Singlet and Triplet Systems in Spectra.* **L. S. Ornstein** and **H. C. Burger.** (Zeits. f. Physik, 40. 6. pp. 403–413, 1926.)—Evidence is given that singlets and triplets and intercombinations (when present) may be grouped together to form an extended multiplet; the sum-rule for intensities may then be applied to the lines of this extended multiplet. This is found to be verifiable when the lines of the multiplet are not very distant from one another. A. C. M.

1752. *Pickering Spectrum in Argon.* **Marya Kahanowicz.** (Accad. Lincei, Atti, 4. pp. 285–291, Oct., 1926.)—Describes a brilliant enhanced spectrum observed in argon at high pressure under a forced *régime.* States it as

$$\nu = R\left(\frac{1}{2^2} - \frac{18^2}{(2m + \frac{1}{2})^2}\right).$$

The emitting particle is of the hydrogenoid type—*i.e.*, a single electron moves within the nucleus. A. D.

1753. *The Coupling of Quantum Vectors of Neon, Argon and the Spectra of the Carbon Group.* **S. Goudsmit** and **E. Back.** (Zeits. f. Physik, 40. 7. pp. 530–538, 1926.)—The Goudsmit and Uhlerbeck demonstration of the different possibilities of coupling in the atom is used by which two electrons are assumed in exchanging positions. Taking into account the spectroscopic facts and the Zeeman effect analysis, one is led to the results that for silicium and the fundamental term for neon and argon the simple coupling scheme of Russell and Saunders is valid. In the case of other schemes the closer approximation of neon to silicium than to tin or lead must be sufficiently satisfied. The paper is illustrated by many tables. S. G. B.

1754. *Series Spectra of Boron, Carbon, Nitrogen, Oxygen and Fluorine.* **I. S. Bowen.** (Phys. Rev. 29. pp. 231–247, Feb., 1927.)—Practically all of the unidentified strong lines of boron, carbon, nitrogen, oxygen, and fluorine occurring in the extreme ultra-violet spectra of the vacuum spark have been classified as due to jumps between levels in B_{I}, C_{I}, C_{II}, N_{II}, N_{III}, O_{II}, O_{III}, O_{IV}, F_{I}, F_{II}, F_{III} and F_{IV}. The levels thus found are correlated with those demanded by the Russell-Heisenberg-Pauli-Hund theory. **Author.**

1755. *Spectra Excited by Active Nitrogen.* **A. E. Ruark, P. D. Foote, P. Rudwick** and **R. L. Chenault.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 17–27, Jan., 1927.)—Evidence in favour of the view that active nitrogen consists of neutral unexcited nitrogen atoms is discussed, and new experiments which support this view are described. No absorption spectrum for active nitrogen was found between 6500 Å. and 3200 Å. It is to be expected in the far ultra-violet on the above hypothesis. New bands of the β system of NO are recorded. The second positive bands of N appear in the afterglow at 0·02-mm. pressure. Mercury atoms can receive at least 10 volts energy from active nitrogen, this being the lower limit of dissociation for atomic nitrogen. The usual rules for multiplet intensities are not valid for afterglow spectra. The afterglow spectra of Zn, Mg, Pt, $SiCl_4$, $TiCl_4$, Na, Cd and Tl are discussed, and it is pointed out that thermochemical data give only negative evidence as to the origin of these spectra. F. S.

1756. *Afterglow of Active Nitrogen.* **K. F. Bonhoeffer** and **G. Kaminsky.** (Zeits. Elektrochem. 32. pp. 536–537; Disc., 537, Nov., 1926. Paper read before Deut. Bunsen-Gesell., Stuttgart, May, 1926.)—Concludes that the afterglow is due to atoms of nitrogen. Though impurities must be present before there is an afterglow, the abnormal distribution of intensities within the bands is independent of the nature of the impurities. The intensity of the light is approximately proportional to the square of the concentration of the active constituent. A. D.

1757. *Rotational Terms in the MgH Bands.* **W. W. Watson** and **P. Rudnick.** (Phys. Rev. 29. pp. 413–418, March, 1927.)—The values of the rotational terms for the vibrational states 1/2, 3/2, and 5/2 in the green MgH bands are tabulated. The Kratzer, Kramers, and Pauli formula is applied to the data with the following values giving the best fit: $j'_{\text{min.}} = \frac{1}{2}$, $j''_{\text{min.}} = \frac{1}{2}$, σ' small ($< \frac{1}{2}$), ϵ' and ϵ'' small ($\cong 0$). The term $m = 1$ exists, thereby making it impossible to let $j = m - 1$. Other predicted electronic quantum numbers are shown to agree less well with the observed ΔF values. **Authors.**

1758. *Excitation of Spectra by Atomic Hydrogen.* **F. L. Mohler.** (Phys. Rev. 29. pp. 419–425, March, 1927.)—Hydrogen from a Wood discharge-tube flowed into a tube containing metal vapour and the spectrum emitted by the mixture was observed. Sodium and cadmium gave strong emission of their first resonance lines and no other lines. Potassium showed the first resonance doublet faintly. Mercury gave the complete hydride spectrum and faint emission of λ2537. Cæsium, magnesium, thallium and zinc gave no line spectra. Two possibilities are suggested. A three-body collision of two hydrogen atoms and a metal atom may result in recombination of the hydrogen and excitation of the metal atom. A metal hydride may first be formed, and this in a two-body collision with a hydrogen atom may react to give H_2 and an excited metal atom. The available energy of excitation is somewhat less in the second case. AUTHOR.

1759. *Stark Patterns observed in Helium.* **J. S. Foster.** (Roy. Soc., Proc. 114. pp. 47–66, Feb. 1, 1927.)—This is a continuation of previous work [see Abstract 741 (1926)]. The discharge-tube used and its method of excitation are described, and a number of Stark patterns taken with a large quartz spectrograph and with a glass prism spectrograph reproduced. Four patterns have been found in parhelium and orthohelium, each constant in its appropriate spectral series. The general characteristics of the effect are reviewed and found to vary mainly in the field strength at which the interesting features appear. Reasons are given for an extensive revision of the effect in helium as reported by Takamine and Kokubu. F. S.

1760. *Resonance Lines of Zinc.* **P. Soleillet.** (Comptes Rendus, 184. p. 149, Jan. 17, 1927.)—Ponomarew and Terenin have shown that the 3076 ($1S - 2p_2$) and 2139 ($1S - 2P$) lines of zinc are excited by all the radiations of the arc together [see Abstract 2374 (1926)]. It is now shown that each line excites only radiations of the same wave-length. F. S.

1761. *Continuous Spectrum of Mercury.* **H. Volkringer.** (Comptes Rendus, 184. pp. 150–151, Jan. 17, 1927.)—Assuming that the vibrator is under a restoring force proportional to the displacement, and suffers retardation proportional to the velocity, an expression is calculated for the frequency emitted. The curve obtained agrees satisfactorily with that already given [see Abstract 1010 (1927)] showing the position of maximum intensity. F. S.

1762. *Regularities in the Arc Spectrum of Lanthanum.* **W. F. Meggers.** (Washington Acad. Sci., J. 17. pp. 25–35, Jan. 18, 1927.)—Use has been made of the temperature classifications of lanthanum lines by King and Carter, and some unpublished Zeeman effects observed by B. E. Moore. A table of relative terms is given, comprising 48 levels in the La 1 spectrum and containing term symbol for each level, relative energy value on the basis of $a^2D_2 = 0 \cdot 0$, level separations of complex terms and a summary of term combinations. The lowest energy (normal state) of the atom is represented by a doublet-D, and the first metastable state by a quartet-F term. The combination of terms is given in detail in another table. Comparison is made with the spectra of Sc I and Yt I. F. S.

1763. *Resonance Absorption and the Output of Fluorescence in the X-Ray Region.* **V. Posejpal.** (Comptes Rendus, 183. pp. 1097–1099, Dec. 6, 1926.)—Auger [see Abstract 2113 (1926)] has found that the fluorescence output is given by $R = 0 \cdot 07$, $0 \cdot 57$ and $0 \cdot 7$ for the K-ring of argon, Kr and Xe severally and by $R = 0 \cdot 25$ for the L-ring of Xe. A general expression for the fluorescence output in the X-Ray region can be deduced [see Abstracts 1051 and 1589 (1926)]. One atom absorbs one quantum $h\nu$—sufficient to ionise the K-ring if the quantum penetrates this ring. The probability of penetration will be $z = ca$ to a first approximation, where a is the radius of the K-ring, and c is a constant. The probability of a penetrating quantum being absorbed by resonance can be shown to be $zp = z \cdot \frac{\tau\omega \cdot m_H}{\rho \cdot \pi a^2}$, where ω = atomic weight, ρ = density, and τ = fluorescent absorbtion coefficient. The output of fluorescence is finally shown to be, as calculated, in good agreement with the observed values. J. E.

1764. *Effect of X-Rays on Thermoluminescence.* **Frances G Wick.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 33–44, Jan., 1927.)—In a previous investigation [see Abstract 105 (1925)] it was found that X-rays produce marked changes in the thermoluminescence of many substances. Fluorite and calcite showed such marked effects that a detailed study was made. This paper gives (1) the effect of temperature on the rate of decay of (*a*) natural substances, (*b*) the same after exposure to X-rays, and (*c*) specimens heated to remove thermoluminescence and then exposed to X-rays; and (2) the effect of exposure to X-rays on (*a*) maximum brightness, and (*b*) rate of decay. The intensity is greater if the specimen is allowed to stand for some time after exposure. An explanation of this is offered. J. E.

1765. *Effect of Exposure to X-rays upon the Thermoluminescence of Some Synthetically Prepared Materials.* **Frances G. Wick** and **Mabel K. Slattery.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 125–132, Feb., 1927.)—Traces of manganese in solid solution in $CaSO_4$ make the substance susceptible to the action of X-rays. The thermoluminescence is green in colour (4800–5600 Å.). The decay of luminescence at 120° C. shows a curve of the persistent type. The maximum brightness for a given substance after exposure shows a straight line relation with temperature. Saturation is reached for low temperatures (260° C.) within an hour's exposure to the rays. Synthetic thermophosphors show an increase in activity on standing a few minutes after exposure. Decreasing slightly the temperature at which a specimen of Mn in $CaSO_4$ was exposed caused an apparent decrease in the energy stored. AUTHORS.

1766. *X-Ray Wave-Length Spectrometer.* **W. W. Nicholas.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 61–70, Jan., 1927.)—Description with diagrams of an X-ray spectrometer with which wave-lengths can be read directly on an ordinary micrometer screw. Adjustments and errors are fully discussed, and it is estimated that the possible error in the measurement of the fifth order of $WK\alpha_1$ is about 0·4 x.u. W. H. GE.

1767 *X-Ray Tube.* **C. Leiss.** (Zeits. f. Physik, 41. 4–5. pp. 395–396, 1927.)—Detailed description with diagram of a porcelain-metal tube of the Siegbahn-Hadding type taking 20 mA at 100 kV. W. H. GE.

1768. *X-Ray Intensity and Current Strength.* **D. Nasledow** and **P. Scharawsky.** (Zeits. f. Physik, 41. 2–3. pp. 155–163, 1927.)—A study of the dependence of X-ray intensity on the number of kathode electrons used to produce the beam. When the current through the tube does not exceed 4 mA the intensity of the K_α and K_β rays of Cu increases according to a linear law with increase of current strength. The proportionality suddenly falls off and a second linear law holds. The transition point is independent of the applied voltage, measurements being given for CuK$_\alpha$ 45, 40, 35 and 30 kV and CuK$_\beta$ 45, 40 and 35 kV. A diagram and a photograph of the apparatus are given. W. H. Ge.

1769. *K X-Rays of Palladium and Silver.* **G. Kellström.** (Zeits. f. Physik, 41. 6–7. pp. 516–523, 1927.)—Precision measurements of the wave-lengths of the α_1, α_2, β_1, β_2 and β_3 rays of palladium and silver and calculations of the refractive indices of calcite for these rays. W. H. Ge.

1770. *L X-Rays of Tantalum.* **I. Wennerlöf.** (Zeits. f. Physik, 41. 6–7. pp. 524–528, 1927.)—Precision measurements of the α_1, α_2, β_1, β_2, β_3, β_4, γ_1, γ_2 and γ_3 rays of tantalum. W. H. Ge.

1771. *Reflection of X-Rays by Crystals as a Problem in the Reflection of Radiation by Parallel Planes.* **S. K. Allison.** (Phys. Rev. 29. pp. 375–379, March, 1927.)—It is pointed out that the previous solutions of the problem of the reflection of radiation from parallel planes by Lamson [see Abstract 1045 (1921)] and Gronwall [see Abstract 1550 (1926)] are physically incorrect, since the intensities, not the amplitudes, of contributions from individual planes have been added. It is shown that a mathematical method due to Darwin [see Abstract 1262 (1914)] leads to a solution identical mathematically with those of Lamson and Gronwall. Using this result, the intensity of reflection is evaluated for certain ranges of the constants directly related to the reflected and transmitted amplitudes due to a single plane. Author.

1772. *X-Ray Refraction and Dispersion in Calcite.* **A. Larsson.** (Zeits. f. Physik, 41. 6–7. pp. 507–515, 1927.)—Accurate experimental observations using the Kα_1 rays of molybdenum and iron. Full details of the apparatus are given. W. H. Ge.

1773. *X-Ray Diffraction in Liquids.* **F. Zernike** and **J. A. Prins.** (Zeits. f. Physik, 41. 2–3. pp. 184–194, 1927.)—A theoretical paper treating X-ray diffraction in liquids as an effect of molecular arrangement and including all the features of the experimental observations. A rigorous treatment with graphical representation of the results is given for a simple case. W. H. Ge.

1774. *The Scattering Power of Sodium Fluoride for X-Rays.* **T. Barth.** (Zeits. f. Physik, 40. 10. pp. 804–805, 1927.)—Experiments show that lines corresponding to unequal indices (311, etc.) come out strongly, while theory indicates their absence. This must be due to the electron configuration [see v. Arkel, Abstract 2764 (1926)]. Bijvoet has shown that the reduction of an outer electron is given by $\psi_0 = \sin 2\pi\rho\frac{\Sigma n^2}{a} \Big/ 2\pi\rho\frac{\Sigma n^3}{a}$ where ρ = radius of shell and a = cube edge. The inner electrons are taken as being fully effective (this is confined to the K-ring). The value of ρ calculated by Grimm and Wolff and modified by Kramers for the sphere of the equivalent rare gas configuration is used. The agreement with experiment is not good, and one must assume smaller values for ρ, or rather seek for the exact electron configuration. J. E.

RADIOACTIVITY.

1775. *Tables of Constants in Radioactivity and X-Rays.* **Irène Curie** and **J. Saphores.** (Tables Annuelles de Constantes et Données Numériques, Paris, 5. pp. 805–843, 1926. Extract.)—The tables are classified into the three main sections: I. Atomic, Electronic and Ionisation; II. X-Rays; III. Radioactivity. *Section I is subdivided as follows*: (1) Electrons, atoms and molecules—isotopes, Avogadro's "N," e/m, fundamental constants, Lorentz-Einstein formula, dimensions of monomolecular layers (on water), properties of monomolecular layers, photoelectric emission (from metallic compounds), photoelectric emission produced by X-rays; (2) electronic emission—photoelectric, thermionic, emission of 27 electrons; (3) ions and electrons in gases—mobility, mobility spectra, molecular affinity of gases for electrons, constants of ionisation by collision, motion of electrons in gases, mechanism of ionisation by α-rays, destruction of molecules H_2 (and N_2) by an electronic current; (4) critical potentials—resonance and ionisation potentials.

Section II, X-rays, is subdivided as follows: (1) Spectra of characteristic X-rays—K-series, L-series, M-series; (2) absorption—coefficients of atomic and molecular absorption, coefficients of mass—absorption as a function of wave-length, absorption of soft X-rays, absorption of X-rays from a Coolidge tube, absorption by crystalline substances, action of magnetic fields on absorption of X-rays; (3) miscellaneous—variation of intensity of radiation independent of nature of antikathode, intensity of characteristic radiation of a Mo antikathode as a function of voltage, total power radiated from a Coolidge tube (tungsten antikathode) as a function of voltage.

Section III, Radioactivity. This section deals with (1) α, β and γ radiations, H-particles and atomic disintegration; (2) diffusion of radioactive emanations; (3) "natural" radioactivity; (4) chemical action of the α, β, γ rays, adsorption, solubility. A. B. W.

1776. *Half-value Period of RaD.* **Theodora Kautz.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 3–4. pp. 93–97, 1926.)—The author has made direct determination of the period of RaD by measuring the decay in the rate of the heat emission for a period extending over fourteen years. The half-value period thus obtained is found to lie between fourteen and sixteen years—in good agreement with that found by Antonoff [see Abstract 1253 (1910)] and by R. Thaller [Wien Ber. 123. p. 157, 1914]. A. B. W.

1777. *An Attempt to Influence Radioactive Disintegration Artificially.* **B. Walter.** (Zeits. f. Physik, 39. 5–6. pp. 337–340, 1926.)—Uranium X_1 was acted on by very hard X-rays, the β-activities before and after the exposure being measured and compared with those of a similar sample which was not thus treated. The result was negative, *i.e.*, the ratio between the activity before and that at the end of a measured time, which included the time of exposure, being within the limits of accuracy of the measurements the same in both cases. Voltages of at least 150 kV were employed in operating the tube, and as the velocities of the electrons sent out in the radioactive disintegration of uranium X_1 correspond to voltages between 71 and 197 kV it was thought possible that some effect might be obtained by this means. H. N. A.

1778. *Pitchblende and its Residues from St. Joachimsthal and the Emanation Given Off by Them.* **J. Markl.** (Phys. Zeits. 28. pp. 10–12, Jan. 1, 1927.)—Contains an account of the ore beds with a short history of their development. Describes experiments in which the emanation given off by the residues obtained after extraction of the uranium from the ore is measured. Since the radium exists here as sulphate emanation is only given off slowly, and from the dry residue only 1·91 % of the theoretical amount of emanation was obtained, this percentage was reduced to 1·7 when the residues were mixed with sand and increased to 3·4 when they were wet. The amount of emanation from the dry substance was very regular, so that it can be used as a secondary standard. H. N. A.

1779. *Passage of Positively Charged Particles Through Helium.* **A. J. Dempster.** (Phil. Mag. 3. pp. 115–127, Jan., 1927.)—The source of the ions employed was a cold lithium anode bombarded by electrons from a hot kathode, protons and hydrogen molecule ions were obtained, and when helium was introduced charged helium atoms. The ions were given a comparatively small velocity by falling through 14 to 1000 volts p.d. and a narrow bundle was deflected in a magnetic field, which was varied gradually so that the different ions in turn passed through a slit to an electrode connected to a string electrometer. Experiments were made with different pressures of helium in the apparatus; they indicated that protons with the velocities indicated above pass through many helium atoms without neutralisation, and with only slight changes in velocity or direction. Hydrogen molecule ions are dissociated with a free path for dissociation about nine times the kinetic theory free path for 900-volt rays, the result is that while with a helium pressure of 0·0077 mm. the effect of these ions on the electrometer was nearly as great as that of the protons it was very much less at 0·021 mm. At the first of these pressures positively charged helium atoms produce a marked effect and none at all at the second, the deduction is made that helium ions are neutralised at about the first collision. H. N. A.

1780. *Effect of α-Particles on Paraffin.* **W. T. Richards.** (Cambridge Phil. Soc., Proc. 23. pp. 516–522, Jan., 1927.)—A glass cylinder forming the reaction chamber was connected to a standardised burette, and the gas formed by the action of the α-rays emitted by an α-ray tube in the interior on solid and on liquid paraffin was measured at definite intervals. The actual amount of gas was small; apparently it was hydrogen, but a complete analysis could not be obtained. More was produced in a given time from the solid than from the liquid paraffin, but it is shown that this was due to the fact that the liquid paraffin filled the whole cylinder, and that only the portion in contact with the α-ray tube was affected, while the solid formed a thin layer on the internal wall of the cylinder. There appeared to be an accumulation of decomposition products in the liquid at the tube surface which acted as a partial screen for the α-rays. When suitable corrections are made it appears that the action of α-particles on paraffin is independent of the state of aggregation.

H. N. A.

1781. *The Contradictions between Experiments on the γ-Radiation of RaC.* **K. W. F. Kohlrausch.** (Phys. Zeits. 28. pp. 1–10, Jan. 1, 1927.)—It is shown that the intensity distribution in the line spectrum of the RaC

γ-radiation obtained by photoelectric measurements, which is to a certain extent supported by the distribution of scattered electrons, does not agree with observations on absorption and scattered radiation, as interpreted by the Compton-Debye system of formulæ. This may be due to lack of definiteness in the experimental arrangements, to incorrect assumptions as to the distribution of the spectral intensities, or to the inapplicability of the above-mentioned formulæ. Since theory and experiment differ in the effective wave-lengths by an octave, it follows that a revision of most of the experiments is necessary. In determining the intensities photography should be replaced by suitable receivers such as counters, Faraday cages or ionisation chambers. The paper contains a detailed treatment of the subject, with a number of tables giving the results obtained by different investigators, and the theoretical deductions. H. N. A.

1782. *Scattering of γ-Rays.* **L. H. Clark.** (Nature, 119. pp. 121–122, Jan. 22, 1927.)—Gray [see Abstract 1435 (1927)] has pointed out that the study of radiations shorter than 0·02 Å. is complicated by scattered radiations. The writer has also shown that the scattered radiations are softer than the γ-rays producing them [see Abstract 2619 (1926)], and this letter gives an account of confirmatory evidence. The scattered radiations are heterogeneous and in order to analyse them experiments are being made with magnetic fields. Experiments have also been made on the effect of lining the electroscope with different substances, and the results indicate a means of detecting changes in the quality of the radiations entering the electroscope. J. E.

1783. *Luminescence due to Radioactivity.* **D. H. Kabakjian.** (Nat. Acad. Sci., Proc. 13. pp. 4–7, Jan., 1927.)—The various theories advanced to explain the peculiarities of the decay with time of the luminescence of radioactive substances are briefly discussed, and it is concluded that three different types of luminescence due to radioactivity can be distinguished, typified respectively by the luminescence of synthetic ZnS in a state of equilibrium after exposure to α-rays, by that of BaBr heated to 550° C. and exposed to α-rays, and by the so-called thermoluminescence of fluorite crystals. In most substances all three types exist at once in varying degrees of intensity, resulting in complex curves representing the rise and decay of luminescence. A. B. C. L.

1784. *A New Determination of the Period of Polonium.* **M. A. da Silva.** (Comptes Rendus, 184. pp. 197–199, Jan. 24, 1927.)—The author in collaboration with Laporte has shown that in pure argon saturation of the current is easily obtained when α-rays of polonium are used to ionise the gas; 50 volts are sufficient to produce saturation. The measurements have been continued for eight months, and the logarithmic curve for the decay of polonium gives 140·2 days for its period. The above value is very near to those of Mme. Curie and of Mlle. Maracineanu, but considerably higher than that of the tables of constants. H. N. A.

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HEAT.

1785. *Thermal Conductivity of Carbon Dioxide.* **H. Gregory and Sybil Marshall.** (Roy. Soc., Proc. 114. pp. 354–366, March 1, 1927.)—Measurements were made by the method used by Gregory and Archer for air and hydrogen, the tubes, however, being vertical instead of horizontal. The double system of electrically heated wires made it possible to identify accurately the critical pressure at which the convective losses became negligible. The values obtained for the absolute thermal conductivity at different temperatures between 4·45° and 12·57° C. were plotted against the temperature, the points lying fairly near to a straight line, which cut the line corresponding to 0° C. at the point indicating a thermal conductivity at this temperature of $3\cdot604 \times 10^{-5}$ cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$. H. N. A.

1786. *Heat Conductivity of Gases.* **S. Weber.** (Ann. d. Physik, 82. 4. pp. 479–503, Feb. 26, 1927.)—The method employed to determine the thermal conductivity of gases makes use of two cylindrical glass tubes of the same diameter and thickness of wall. The tubes are of unequal lengths and are maintained in a vertical position. Each has a fine platinum wire along the axis, the lengths being unequal, and these wires are secured to thicker wires passing through the ends of the tubes. The tubes are connected at the top by branches sealed into a tube which is used for filling purposes and to vary the pressure of the contained gas. An electric current is passed through the wires and observations are made in the steady state. Theory of the method is given. Results obtained by this method for hydrogen are in close agreement with results obtained by the author some years ago, and also with the results of Schneider. Schneider's result for dry air free from carbon dioxide is about 4 % greater than that found by Weber, which is in very close agreement with that obtained by Gregory and Archer using Goldschmidt's method, the respective figures being $574\cdot0 \times 10^{-7}$ and $576\cdot1 \times 10^{-7}$ gm. cal./sec. degree cm. A. W.

1787. *Thermal Expansion of the Free Space in Liquids.* **W. Herz.** (Zeits. Elektrochem. 33. pp. 76–77, Feb., 1927.)—Within certain ranges the volume change of a liquid with temperature can be expressed by Mendeleieff's formula $v_t = v_0/(1 - kt)$, where k is the modulus of expansion. That this formula can also be applied to the free space $V_f = M/d - M/d_0$ [see Abstract 1605 (1926)] is shown for pentane, hexane, heptane and octane within the range 0 to 90° C. For the free space the k is roughly three times as large as the k for the mol. volume. H. B.

1788. *The Deformation of Double Metallic Strips by Alteration of Temperature.* **H. Bock.** (Zeits. Instrumentenk. 46. pp. 601–609, Dec., 1926.)—On the basis of a simple technical theory of elasticity the formulæ for the temperature deformation of bimetallic strips is deduced, and it is mathematically shown that compensation for variation of the elasticity of spiral steel can be attained and the consequences of the tension in such strips are explained. The practical application of the theory is shown in the case of balance wheels of watches, etc. S. G. B.

1789. *Thermally Excited Quantum Emission in Solid Bodies.* **F. Simon.** (Preuss. Akad. Wiss. Berlin, Ber. 32–33. pp. 477–487, 1926.)—Consideration has been given to the changes of specific heat with temperature of a series of monatomic, regular crystalline substances, and it is shown that their atoms are capable of existing in two states so little different that the distribution taking place in the homogeneous system occurs at very low temperatures. The energy difference of the two states, on the nature of which nothing definite can be said yet, is of the order of magnitude of 1 % of the lattice energy. The substances dealt with are grey Sn, Si, diamond, Na, K, Fe, Ni and Co. For the diamond, confirmation is provided by optical measurements on absorption, while the Grüneisen formula of the proportionality of thermal expansion and specific heat for isotropic bodies provides an independent measure of the point of abnormal increase of specific heat. For the alkali metals support is provided by values of electrical resistance and by the Lindemann melting point formula. Finally, several conclusions regarding the physical and chemical behaviour of these substances are discussed. R. S. R.

1790. *Investigation in the Critical Region. Part II. Specific Heat of Ethyl Ether above and below the Critical Temperature.* **K. Bennewitz** and **H. Wendroth.** (Zeits. phys. Chem. 135. 1–2. pp. 111–134, Jan., 1927.)—With a calorimeter of a type similar to that employed in an earlier investigation [see Abstract 718 (1927)] determinations are made of the thermal dilatation coefficient of ethyl ether and its specific heat at constant pressure (C_p) over a temperature range of from 30° to 215° C., the pressure being maintained at 40 atmos., or slightly above the critical pressure. Volume changes are determined by measuring electrically the amount of mercury displaced in a steel side tube connecting with the calorimeter container. The change of specific volume with temperature is plotted on a curve and compared with the values given by the van der Waal equation using the values for the constants determined by Young. In the neighbourhood of the critical temperature, $Tc = 193 \cdot 8°$ C., the curve of the measured values shows a characteristic break and departs from the theoretical curve. At about 20° above the critical temperature, agreement between the curves is obtained. The slope of the curve giving the rise of C_p with T increases with temperature and in the neighbourhood of T_c has a form which on extrapolation indicates an infinitely high value of C_p at T_c. Beyond this temperature a very sharp fall of C_p to a lower value than for the liquid phase occurs, and again rises with further increase of temperature. J. N. P.

1791. *Measurements of the Velocity of Sound in Steam, Nitrous Oxide and Carbon Dioxide with Special Reference to the Temperature Coefficient of the Molecular Heats.* **W. G. Shilling.** (Phil. Mag. 3. pp. 273–301, Feb., 1927.)—Kundt's method was employed, using a silica tube with a bore of 4 cm. and 210 cm. long, the piston head and rod were also of silica, and carried the thermocouple. Coils of wire round the outside tube enabled the whole to be heated to various temperatures up to 1150° C. A note was sounded at one end of the tube by means of a telephone enclosed in a metal, cylindrical, water-jacketed end-piece, cemented to one end of the quartz tube; the diaphragm was perpendicular to the tube axis, and when the quartz piston was properly adjusted nodes and loops were formed in the length of tube between diaphragm and piston. These were adjusted so that a maximum of sound was heard at the end of a side tube connected to the metal end piece, and the piston was moved through measured distances to the positions of successive maxima. With steam direct observation at the end of the side tube was not possible, and a microphone was employed with a two valve amplifier. The following equations were found to hold for C_v and C_p in cal./gm. mol. at t° C.; $C_v = 6 \cdot 688 + 0 \cdot 00423\,t - 0 \cdot 0_6 712\,t^2$ for CO_2, $6 \cdot 629 + 0 \cdot 00694\,t - 0 \cdot 0_5 241\,t^2$ for N_2O, and $7 \cdot 266 - 0 \cdot 00763\,t + 0 \cdot 0_4 1261\,t^2 - 0 \cdot 0_8 401\,t^3$ for steam; $C_p = 8 \cdot 708 + 0 \cdot 00415\,t - 0 \cdot 0_6 650\,t^2$ for CO_2, $8 \cdot 659 + 0 \cdot 00677\,t - 0 \cdot 0_5 222\,t^2$ for N_2O; and $9 \cdot 596 - 0 \cdot 00925\,t + 0 \cdot 0_4 148\,t^2 - 0 \cdot 0_8 508\,t^3$ for steam. Chemically pure gases were employed. H. N. A.

1792. *The Specific Heat of a Sufficiently Cooled Condensed Phase.* **J. E. Verschaffelt.** (Comptes Rendus, 184. pp. 603–604, March 7, 1927.)—The author takes exception to two propositions contained in a Note of Perrakis under the same title as above [see Abstract 1445 (1927)], *viz.*, (1) Trouton's rule affirms that the quotient L/T is the same for every (normal) body at the boiling point, *but not that this quotient is independent of the temperature.* (2) Perrakis, at low temperatures, identifies σ_2, the specific heat at saturation, with $(C_p)_2$, the specific heat of the vapour phase at constant pressure. But from the fact that in the diagram pv the saturation curve approaches asymptotically the axis $p = 0$, it does not follow that the pressure tends to become constant, but only that it approaches zero. T. B.

1793. *An Apparatus for the Thermal Analysis of Plaster of Paris.* **Jolibois** and **Chassevent.** (Comptes Rendus, 184, pp. 202–204, Jan. 24, 1927.)—The vessel containing the mixed paste has a tube, passing through the cover into the paste, in which a thermometer is placed. The vessel is placed in an air space surrounded by a water jacket, which is heated electrically and kept at the temperature of the setting plaster. The whole apparatus is covered with felt. Temperature-time curves are given for plaster prepared in different ways. It is shown that the velocity of hydration can be determined, and that it is possible to control and classify industrial products according to their properties, the commencement of setting, the velocity of transformation into gypsum, the composition and the resistance to compression. H. N. A.

1794. *Vapour Tension and the Use of the Resistance Thermometer in the Temperature Range of Liquid Nitrogen and Hydrogen.* **F. Henning.** (Zeits. f. Physik, 40. 10. pp. 775–785, 1927.)—The saturation pressure of liquid and solid nitrogen between 80° K and 60° K as also the saturation pressure for hydrogen between 20·4° K and 14·0° K were measured experimentally. The resistance of pure platinum was also measured over the same temperature interval. The temperatures were determined throughout by a helium gas thermometer at constant volume. The validity of the Reichsanstalt formula for the use of the Pt thermometer at low temperatures is tested and the experimental results embodied in a series of tables. Full details of experimental methods are included. S. G. B.

1795. *Mol.-Degree Thermometer for the Cryoscopy of Aqueous Solutions.* **H. Menzel.** (Zeits. Elektrochem. 33. pp. 63–69, Feb., 1927.)—The new thermometer is intended less for the determination of molecular weights than for the determination of the osmotic concentration of aqueous electrolytes. An infinite dilution of one mol. of a substance, which is neither dissociated nor associated in its solution in 1000 gm. of water, shows a freezing-point depression E = 1·860° C., and in such work the depression read off has to be divided by this value of E. In order to avoid this calculation the new thermometer is calibrated in mol.-degrees of 1·860° C.; the reading then approximately indicates directly the osmotic concentration. The thermometer (made by R. Goetze, Leipzig) is divided into 0·005 mol.-degrees, and the range roughly corresponds to 5° C. The use of the thermometer and the corrections are explained and exemplified by observations taken on hydrogen peroxide (typical monomolecular, practically undissociated substance), potassium chloride (binary electrolyte) and magnesium chloride (ternary electrolyte). H. B.

1796. *Automatic Low-Temperature Thermostat.* **O. Maass** and **W. H. Barnes.** (Am. Chem. Soc., J. 49. pp. 360–363, Feb., 1927.)—An automatic thermostat functioning between laboratory temperature and that of liquid air is described. Constancy of temperature to 0·1° C. is assured. The thermostat bath consists of the first distillate of petrol ether which is cooled by liquid air in a copper bulb contained in the ether. New additions of liquid air are automatically forced into this bulb as the temperature rises. The original paper must be consulted for details. L. M. C.

1797. *A New Pyrheliometer.* **P. Paunow.** (Zeits. techn. Physik, 8. 2. pp. 77–79, 1927.)—A thin circular metal disc is clamped in a heavy ring of the same metal, and the sun's rays are allowed to fall upon the central portion of the disc through a circular opening in a diaphragm, heating it and causing it to expand. The supporting ring, though also in the sunlight, is not heated to the same temperature, since it is connected to a metal box, so that the total cooling surface is large. The expansion causes the disc to bend to watch-glass form, and the movement is magnified by means of a lever arrangement carrying a mirror. The bending is considerably greater than the linear expansion of the metal. The angle through which the mirror turns is observed by means of an attached telescope. The instrument has been modified so that it can be used as a pyrheliograph. H. N. A.

1798. *Variations of Thermal Capacity in Magnetic Field.* **Bianca Nannei.** (Accad. Lincei, Atti, 4. pp. 296–300, Oct., 1926.)—A differential method of measuring these variations worked out and described. A. D.

1799. *Simple Evidence of the Invalidity of Dalton's Law in the Case of Real Gases.* **M. Jakob.** (Zeits. f. Physik, 41. 10. pp. 737–738, 1927.)—The invalidity of Dalton's law of pressures is demonstrated graphically by considering the mixture of two equal volumes of the same gas under the same pressure and at the same temperature. The result depends upon the inconstancy of *pv* at constant temperature. J. S. G. T.

1800. *A Pressure Effect relating to the Mixture of Gases.* **M. Jakob.** (Zeits. f. Physik, 41. 10. pp. 739–742, 1927.)—The results of Holborn and Otto relating to the isotherms of mixtures of helium and neon indicate that on mixture of these two gases under equal pressures and at the same temperature a change of pressure of the order 2 parts per 1000 is produced. J. S. G. T.

1801. *Size-Distribution among Gaseous Ions.* **P. J. Nolan.** (Ann. d. Physik, 82. 2. pp. 273–274, Jan. 12, 1927.)—Reply to Busse [Abstract 406 (1927)]. Does not agree with the explanation offered. G. E. A.

1802. *Relation between the Reciprocal Impenetrability of Matter and Pauli's Exclusion Principle.* **P. Ehrenfest.** (Nature, 119. p. 196, Feb. 5, 1927.)—It is impossible to quantise the motion of a gas by means of the "classical" quantum theory when considering collisions between the molecules of an ideal gas. By treatment of an ideal gas by "undulatory" mechanics, an exact and elementary solution can be given for the problem set out above, assuming a case of impenetrable moving "mass points." Hitherto the impenetrability of the walls of the vessel have been allowed for, but not the reciprocal impenetrability of the molecules. The results of the mathematical treatment show that the impenetrability of the walls and for the molecules must be expressed by the corresponding zero-conditions of the Schrödinger equation [see Abtract 1401 (1926)]. Simple models for the treatment of the limitations of Pauli's exclusion principle as regards two electrons in the same atom are suggested, and the non-validity of Pauli's principle for "light corpuscles" is possibly connected with their reciprocal "penetrability." The remarks are to be amplified elsewhere. S. G. B.

1803. *The Mechanical Wave Interpretation of Boltzmann's Statistics and that of the Newer Statistics.* **P. Ehrenfest** and **G. E. Uhlenbeck.** (Zeits. f. Physik, 41. 1. pp. 24–26, 1927.)—A mathematical note on the interpretation of the statistical methods of Boltzmann-Planck, Bose-Einstein, and Pauli-Fermi-Dirac, according to the wave theory. The authors illustrate the limitations of the Boltzmann-Planck method by considering a special case of a one-dimensional ideal gas. T. B.

1804. *The Einstein Mixture-Paradox.* **P. Ehrenfest** and **G. E. Uhlenbeck.** (Zeits. f. Physik, 41. 8–9. pp. 576–582, 1927.)—Although the Bose-Einstein like the Fermi-Dirac statistics [see Abstract 1609 (1926)] lead, when applied to the perfect gas, to the Einstein *mixture-paradox* (*i.e.*, at sufficiently low temperatures), the pressure or average energy of N falls throughout the same molecules discontinuously; the present authors show that this can be explained from the standpoint of the several dimensional wave mechanics. The paper is entirely mathematical, and considers reciprocal penetrable and impenetrable molecules and uniform and varying groups of like molecules. H. H. Ho.

1805. *Mean Free Paths in a Gas.* **E. Condon** and **E. van Amringe.** (Phil. Mag. 3. pp. 604–614, March, 1927.)—The mean free paths in a gas whose molecules are regarded as rigid elastic spheres are mathematically investigated. The results show that the Maxwell mean free path is accurately represented by a formula of the Sutherland type, in which Sutherland's constant C is to be interpreted as the ratio of the energy of two molecules in contact to the gas-constant per molecule. The mean free path appropriate to the transfer theory of viscosity is *approximately* represented by a formula of the Sutherland type, in which C is interpreted as about three-fourths of the above ratio. The results lead to a direct method of evaluating the energy of two molecules in contact by means of the experimental data on the temperature coefficient of viscosity. J. J. S.

1806. *Mechanism of Uniform Movement in Flame Propagation.* **H. F. Coward** and **G. W. Jones.** (Am. Chem. Soc., J. 49. pp. 386–396, Feb., 1927.)—The speed of uniform movement of flame in mixtures of methane with air and with "artificial" atmospheres composed of 20·9 % oxygen with the remainder argon or helium, has been determined in tubes of varying diameter for upward, horizontal and downward propagation of flame. Mixtures having the same percentage of argon or of helium have the following properties identical, (1) the heats of combustion, (2) thermal capacity, (3) temperature of combustion (heat losses being assumed equal), and therefore (4) the rate of combustion (temperature of combustion being the same). The helium mixtures have a greater heat conductivity and a less absorptive power for radiation than those in which the diluent is argon. In tubes of 2·5 cm. diameter, flame travels more rapidly in helium than in argon mixtures, but not to the extent which would be suggested by the difference in conductivity. In wider tubes the difference becomes still less, while speed of flame is greater with increasing diameter. Maximum speeds with varying proportion of methane are obtained when rather more than the theoretical amount of methane which can be completely burnt is present [see Payman, Abstract 731 (1920)]. The chief factors influencing flame speed are therefore the heat developed in the flame, the heat capacities of the burnt and unburnt mixture, and the rate of chemical reaction. L. M. C.

1807. *Movement of Flame in Closed Vessels. After-Burning.* **O. C. de C. Ellis** and **R. V. Wheeler.** (Chem. Soc., J. pp. 310–322, Feb., 1927.)—When an explosive CO-air mixture is ignited by a spark in the centre of a glass sphere (9 cm. diam.), the flame travels in a spherical shell outward, not compressing the unburnt gas in front of it appreciably until the wall is nearly reached (phase I); then the movement slackens, and the pressure gradient reverses (phase II). In phase II the centre of the sphere, so far dark, brightens up again (re-illumination), and this luminescence decreases slowly, first on the outside. Phase II began after 13·7 millisec., and the light remained visible altogether for 77·7 millisec.; a reddish glow is observed after this light disappears. In a horizontal cylinder the light boundary, first spherical, soon turns oval; in other vessels the phenomena are more complex. The re-illumination might be due (1) to recombination of dissociated molecules of CO_2 or steam—this could only take place on cooling, but the gases are being compressed and must be getting hotter; the glow might, however, be due to re-association; (2) to dissociation of molecules, but the distribution of the luminescence is against that; (3) to the completion of the burning, the after-burning suggested by Dugald Clerk to account for the loss of pressure in gas-engines. That this after-burning (3) is the real explanation is confirmed by experiments with mixtures of CO, O, steam and other gases. When the CO is all burnt by an excess of oxygen during phase I, there is no after-burning. The duration of after-burning decreases rapidly as the amount of moisture is increased, because the flame propagation in I is then rapid ; 4 % of moisture by volume accelerated the flame propagation most in the presence of diluents, CO_2, N, O, Ar, He, CO, in this order, and this effect was particularly striking when CO itself was used as diluent. The duration of the after-burning, on the other hand, was most striking in the presence of argon, for which a flame temperature of 3520° K. was calculated ; there was no after-burning in CO_2 mixtures (temperature 2230° K.). The actinic power of the re-illumination-luminescences ascribed to the after-burning of CO at high-temperature and pressure is much greater than that of the flame itself. H. B.

1808. *Ignition Point of Gases at Different Pressures.* **H. B. Dixon** and **W. F. Higgins.** (Manchester Phil. Soc., Mem. 70. pp. 29–36, 1925–1926.)—A preliminary account is given of experiments made on the ignition points of gases in a new form of the concentric-tube apparatus designed to work under pressure above or below that of the atmosphere. As the pressure was increased from 1 to 7 atmos. the ignition points of methane in air regularly fell, and when the pressure was reduced below atmospheric the ignition points of methane rose. In the case of hydrogen as the pressure was increased above atmospheric there was a small rise in the ignition point which reached a maximum at 1000-mm. pressure ; above this the ignition points fell regularly. When the pressure was reduced below atmospheric the ignition points fell at first slowly and then more and more quickly, so that there was more than 100° difference between the ignition points at 760 mm. and at 75 mm. This fall in the ignition point at very low pressures as well as at high pressures appears to be a general property of combustible gases. It has yet to be explained. J. J. S.

1809. *Ignition of Gases. Part VI. Ignition by Flames of Methane-Air and Paraffin-Air Mixtures.* **N. S. Walls** and **R. V. Wheeler.** (Chem. Soc., J. pp. 291–297, Feb., 1927.)—For Part V see Abstract 1145 (1925). While methane-air mixtures are most readily ignited by contact with hot walls when containing 5 to 6 % methane (the test being based upon the estimate of the ignition temperature, *i.e.*, the lowest wall temperature required for inflammation irrespective of duration of contact), electric sparks most readily ignite mixtures of 8·25 to 8·5 %. With wall heating there is always a time lag. Ignition by a momentary source of high temperature is characteristic more for the propagation of the flame than for its initiation. In the new experiments the gas is contained in a vertical cylinder closed above by a cap of brass, provided with a hole 1 cm. in diameter ; over this cap is drawn a steel tape, provided with corresponding holes, and ignition is effected by a flame playing vertically downward from a silica jet. This standard flame must carefully be aerated, as it would otherwise abstract oxygen from the mixture. With a flame area of 20 sq. mm. the shortest time of contact required for ignition, 7 millisec., was observed with methane mixtures of about 10 %, against 12·4 millisec. at 7·9 % ; with a flame area of 75 sq. mm. 3·5 millisec. sufficed at about the same concentration (10 %), but the effect of varying the concentration was smaller with large flames. Similar results were obtained with ethane, propane and pentane, the times decreasing in this order. Ease of ignition depends essentially upon the ability of the flame to travel after the source of ignition has been removed. H. B.

1810. *Detonation of Gaseous Mixtures of Acetylene and of Pentane.* **A. Egerton** and **S. F. Gates.** (Roy. Soc., Proc. 114. pp. 137–151, March 1, 1927.)—The purpose of the work described was to find the position, in a tube of an internal diameter of 0·9 in., at which a burning mixture of gases would develop detonation. Mixtures of acetylene and pentane vapour were investigated, with sufficient oxygen for complete combustion, and diluted with various amounts of N, O, A, CO_2, and excess of fuel. Photographs were taken with a rotating wheel camera, the wheel being of 1-metre circumference, and attaining a peripheral speed of 170 metres per sec., though the speed generally employed was only 10 metres per sec. Tables and graphs are given and show that O accelerates combustion, and detonation with O or A occurs earlier than with a similar quantity of N. Great excess of combustible has a delaying effect. CO_2 has a greater delaying effect than N. Detonation always appears to take place slightly ahead of the combustion front. Experiments were made to determine the effect of " anti-knocks " like lead ethyl and diethyl selenide. No evidence was found of any delay of detonation at ordinary initial pressures and temperatures. T. B.

1811. *Detonation in Gaseous Mixtures at High Initial Pressures and Temperatures.* **A. Egerton** and **S. F. Gates.** (Roy. Soc., Proc. 114. pp. 152–160, March 1, 1927.)—The work described in the previous investigation [see preceding Abstract] is extended to higher pressures (10 atmospheres) and temperatures (230° C.). Previous investigations, up to 4 atmospheres and 125° C., are referred to [see Abstract 2903 (1926)]. The measurements of the present paper, which were made in a steel tube fitted with glass windows, cover the region of the usual compression employed in an internal combustion engine. The mixtures used are acetylene or pentane with O or N. Increase in initial pressure is found to increase the tendency to detonation up to about 3 atmospheres; further increase in initial pressure has very little effect. For a given initial pressure, an increase in initial temperature appears to render detonation slightly later. Results are given which show that the presence of lead tetra ethyl and nickel carbonyl does not delay detonation under the conditions investigated. T. B.

1812. *Propagation of Detonation across an Air Gap between Two Cartridges of Explosive.* **G. S. J. Perrott** and **D. B. Gawthrop.** (Frank. Inst., J. 203. pp. 387–406, March, 1927.)—The paper describes a study of the velocity of propagation of detonation across an air gap between two explosive cartridges 1¼ in. in diameter and 7 in. long. The explosives used were a 40 % straight nitroglycerine dynamite and seven explosives of the ammonium nitrate—nitroglycerine type. Measurements were made both by the Mettegang recorder and by a photographic method previously described [see Abstract 1461 (1927)]. The length of air gap varied from 1½ to 12 ins., or in some cases up to 48 in. Curves are given which illustrate that in the case of an explosive with a low rate of detonation (1700 metres per sec.) the velocity of propagation across an air gap is at first greater than the rate within the explosive itself. For an explosive with a high rate of detonation (4800 metres per sec.) the velocity across the air gap is equal to this rate per 1½ in., but falls off rapidly as the air gap is increased, until with a gap of 48 in. the second cartridge fails to detonate. When the explosives are confined in glass tubes, the speed across the air gap is considerably increased. T. B.

1813. *Vapour Pressures and Melting Points of Sodium and Potassium.* **W. Edmondson** and **A. Egerton.** (Roy. Soc., Proc. 113. pp. 520–533, Jan. 1, 1927.)—In the experimental determination by the effusion method of the vapour pressures of Na and K between 100° and 200° C., special difficulties arise from the great reactivity of the alkali metal vapours. The action of Na on glass is indicated to be mainly due to the metal absorbed within the glass at the temperatures of the experiments. A special type of thermostatic control is designed having for its object the obviation of difficulties at the mercury contact surface. The results obtained are compared with those of other observers, whose methods are briefly discussed as to possible sources of error; a good general accord is noted. Curves embodying the principal available data are given which express for the vapour pressure of K the equations

$$\log \gamma_{\text{mm.}} = -\, 4507 \cdot {}_0/\text{T} + 7 \cdot 3447,$$

and for that of Na the equation

$$\log \gamma_{\text{mm.}} = -\, 5573 \cdot 2_7/\text{T} + 9 \cdot 7255 - 0 \cdot 6794 \log \text{T}.$$

The purity of the Na and K employed in the determinations is tested by finding the melting points. The melting point of Na is given as $97 \cdot 7°$ C., and that of K as $63 \cdot 6_5 \pm 0 \cdot 05°$ C. A. B. C. L.

1814. *Chemical and Other Thermal Constants of Sodium and Potassium.* **W. Edmondson** and **A. Egerton.** (Roy. Soc., Proc. 113. pp. 533–542, Jan. 1, 1927.)—Using data obtained as described in a previous paper [see preceding Abstract] for the vapour pressures, the latent heats of vaporisation at absolute zero of Na and K are computed to be 25,800 calories and 21,460 calories respectively. Values are calculated for the respective chemical constants as given in the equations $C_K = 0 \cdot 92 \pm 0 \cdot 04$ and $C_{Na} = 0 \cdot 63 \pm 0 \cdot 03$. These figures are higher than the values based on the Sackur theory by an amount greater than the probable error, and less, by an amount greater than the probable error, than the theoretical value of the constant + log 2. They are, however, within the possible error. The bearing of the results of later determinations by other workers on the specific heats of Na and K at low temperatures on the calculations undertaken in the present paper are discussed. A. B. C. L.

1815. *A New Pressure Temperature Formula for Vapours.* **A. Batschinski.** (Nature, 119. p. 198, Feb. 5, 1927.)—Formulæ proposed to represent the relation between the pressure p and temperature t usually fail to reproduce experimental results over the whole of the vapour-pressure curve, and give inexact results at low temperatures or near the critical point, which is not usually reproduced as the singular point of the pressure temperature curve. The formula

$$t + c = \text{K}[\sqrt[4]{p} - 10^{a - \text{B}/\log p_K - \log p}],$$

where p_K is the critical pressure and c, K, α, B are constants, different for different substances. This formula represents with sufficient accuracy most varied substances, *e.g.*, liquid metals such as Hg in the whole interval from 0° C. to 880° C., organic liquids, and permanent gases. The case of helium and the anomaly in the case of water are discussed. A detailed account follows in another journal. S. G. B.

1816. *The Effect of the Pressure of an "Indifferent" Gas on the Concentration and Activity of a Vapour in Equilibrium with a Condensed Phase or System of Condensed Phases. Part II.* **I. R. McHaffie.** (Phil. Mag. 3. pp. 497–510, Feb., 1927.)—A former paper [see Abstract 1400 (1926)] dealt with the effect of the presence of air on the concentration and activity of water vapour in equilibrium with the solid phases $Na_2SO_4 10H_2O - Na_2SO_4$. The present paper describes the results obtained using water at 25° C. as the condensed phase with air from 1 to 100 atmos. It has been shown that the relative activity of the vapour, a_p, is given by $\log a_p = PV_s/RT$, where P is the partial pressure of the indifferent gas, and V_s is the molar, volume of liquid water. Also if c_p is the concentration of water vapour in equilibrium with the liquid phase, and C_0 the concentration when the system is in a standard state, the approximation is made that $a_p = C_p/C_0$. Then the relative activity coefficient, f_p, is given by $\log f_p = PV_s/RT + \log C_0 - \log C_p$. The results of the experiments are given in tables and also graphically, the concentrations being plotted against pressure. As with the sodium sulphate system, two distinct curves are obtained. The presence of filters is found to exert an influence on the values determined. T. B.

1817. *Improved Dynamic Method for Measuring Vapour Pressures.* **J. N. Pearce** and **R. D. Snow.** (J. Phys. Chem. 31. pp. 231–245, Feb., 1927.)—The previous methods and results of vapour-pressure measurements were reviewed and discussed. A method of determining the vapour pressures was developed. The method consisted in preparing a known volume of oxygen and hydrogen electrolytically, the quantity being calculated from the silver deposited in the silver coulombmeter, which was in series with the electrolytic cells. The gases were then passed through a battery of saturators, and next through a bank on absorbers filled with beads coated with phosphorus pentoxide. The absorbers were weighed before and after the experiments. The actual calculations were made from three single values, *viz.*, the corrected barometric pressure P, the weight of the vapour Ww taken up by the absorbers, while Ws grammes of silver were deposited in the coulombmeter. The number of mols. of water vapour N_1 and the total number of mols. of hydrogen and oxygen N_2 are calculated from Ww and Ws respectively. The vapour pressure of the solvent is given by the equation $p = N_2N_1 + N_2P$. The method was used to determine the vapour pressures of pure water and aqueous solutions of potassium chloride and mannite at 25° C. F. J. B.

1818. *Vapour Pressures of the Alkali Metals.* **H. Rowe.** (Phil. Mag. 3. pp. 534–546, March, 1927.)—The paper does not include any new measurements, but the formulæ used to express the existing data are compared, both in the range covered by experiment and as regards the values given by extrapolation to 0° C. T. M. L.

1819. *A Consequence of the Non-Existence of the Absolute Zero Point.* **W. Jazyna.** (Zeits. f. Physik, 41. 2–3. pp. 211–213, 1927.)—A brief note showing that in nature matter cannot exist independently of heat, and that according to the arguments put forth an absolute zero which, according to the reciprocal theory, is only a theoretical quantity, has no physical reality. The paper is theoretical throughout. S. G. B.

1820. *Molecular Association and Mechanism of Separation into Two Phases.* **G. N. Antonoff.** (Phil. Mag. 3. pp. 571–580, March, 1927.)—The author's theory has been outlined in a number of recently published papers, and his conclusions differ from the usually accepted views quantitatively. Most authors who deal with the subject assume that the associated molecules consist of only a few simple molecules, and that the degree of association remains nearly the same at different temperatures. In the new theory the association factor varies with the temperature, and may reach such values as 10,000 at low temperatures; this implies that if the number of simple molecules in 1 c.c. of liquid is of the order 10^{21} the number of associated molecules would be 10^{17}. Water at about 4° C. is the only abnormal liquid the author has found. The van de Waals formula is regarded as invalid for liquids. The discontinuous character of the temperature changes and the peculiar characteristic of the critical region below and above the critical point, show that change of state is intimately connected with change of molecular aggregation. H. N. A.

1821. *The Foundation of the Second Law of Thermodynamics.* **M. Planck.** (Preuss. Akad. Wiss. Berlin, Ber. 30–31. pp. 453–463, 1926.)—After a discussion of the axioms on which the second law of thermodynamics has been based, and a statement of the advantages and drawbacks of W. Thomson's axiom and that of Carathéodory, the author proceeds to deduce the second law by a process which has advantages over Carathéodory's method (*i.e.*, of not using a cyclic process or the properties of a perfect gas) and over Thomson's principle of the impossibility of perpetual motion. The passage of a system from a state Z to a state Z′ is considered, the meaning of " probability " in this connection is stated, and a function of the state Z is found whose magnitude is a measure of the probability. The second law is then contained in the statement that for all processes in nature this function cannot decrease. The proof for two bodies that the sum of their entropies in any state is a measure of the probability of the state is then given, and finally this is generalized for any number of bodies. T. B.

SOUND.

1822. *Vibration of Circular Membranes.* **H. Backhaus** and **F. Trendelenburg.** (Zeits. techn. Physik, 7. 12. pp. 630–635, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The field in the neighbourhood of a circular membrane vibrating with high frequency so that the wave-length is short compared with the diameter is investigated theoretically and practically. Curves for different frequencies are given. G. A. S.

1823. *New Acoustic Generator.* **J. Hartmann** and **B. Trolle.** (Journ. Sci. Instruments, 4. pp. 101–111, Jan., 1927.)—Substantially given in a former paper [see Abstract 348 (1923).] The essential part is an air-jet with velocity higher than that of sound. Mach first demonstrated the periodic structure of the jet by photographs, and Prandtl explained its structure. The division of the jet into sections arises from waves emitted from the edge of the jet-orifice. The waves cross and recross the jet, being reflected from the jet surface. Certain features in design are pointed out, *e.g.*, the diameter of the oscillator placed in the path of the jet should be about the same as that of the jet nozzle, the depth of the oscillator from one to two times its diameter. The pressure should not go beyond a certain limit, as the structure of the jet then breaks down. A table gives the variation of frequency with size of oscillator, and a theory of the generator is appended. G. E. A.

1824. *Sound Propagation in Underground Pipes.* **J. Thovert.** (Comptes Rendus, 184. pp. 517–518, Feb. 28, 1927.)—In the experiments of Vautier carried out in water-pipes of 1-m. diameter, a temperature difference of 0·8° C. was found between the top and bottom of the pipe in any one cross-section. The influence of this and of the consequent difference in the hygrometric state upon the actual length of path traversed is discussed. W. H. Ge.

1825. *Energy of a Struck String.* **W. H. George** and **H. E. Beckett.** (Roy. Soc., Proc. 114. pp. 111–137, Feb. 1, 1927.)—Using a suitably designed metal hammer very nearly equivalent to a simple pendulum, the loss of energy on rebound from a string struck transversely is a measure of the energy communicated to the string. From a series of graphs obtained by experiment the following results are evident: The energy lost by the hammer is a discontinuous function of the position of the impact. As the position of the impact moves away from a bridge the energy lost by the hammer increases exponentially until a point of maximum energy loss is reached. The position of the point of maximum energy loss is a continuous function of the mass of the hammer, and is nearer the bridge the heavier the hammer. Measurement of the duration of the impact shows that for maximum energy loss by the hammer the conditions are such that the hammer rebounds just before the wave reflected from the farther bridge reaches the point of impact. The maximum fraction of the hammer's initial energy lost during the impact decreases continuously with increase in the mass of the hammer, but the absolute value of the energy lost increases continuously with increase in the mass of the hammer. For very light hammers—*i.e.*, where the hammer has about one-third of the mass of the string—the energy lost by the hammer remains almost constant at its maximum value as the position of the impact is moved for a considerable distance along the string. G. A. S.

1826. *Measurement of Sound Fields.* **E. Meyer.** (Zeits. techn. Physik, 7. 12. pp. 609–610, 1926. Elek. Nachrichten. 4. pp. 86–90, Feb., 1927. From the Telegraphentechn. Reichsamt.)—Measurements of velocity and pressure amplitudes are sufficient to determine a sound field. In the case of a stationary field the latter is measured by means of a Rayleigh disc and the former by means of a suitable condenser microphone. Objective tests of loud speakers can thus be made, and results are given for speakers with horns of different materials. In non-stationary fields the growth and decay of sound energy in closed spaces are investigated qualitatively with a sound recorder, which is described. G. A. S.

1827. *Nature and Artificial Production of the (so-called) Voiced and Unvoiced Sounds.* **R. A. S. Paget.** (Roy. Soc., Proc. 114. pp. 98–102, Feb. 1, 1927.)—The results of experiments (1) with a perforated mouth stopper made of plasticene and fitted with a window and with an internal lamp, and (2) with a model in which the soft palate and palatal arch and fixed vocal chords are of plasticene and the pharynx is represented by a rubber tube 1 in. in bore, show that the unphonated b, d, v, etc., or p, t, f, etc., series of consonants may be produced in two alternative ways. If the aperture at the vocal chords and that above these are both large or both small, the b, d, v series is produced, whereas if either of the apertures is large and the other small, the p, t, f sounds are produced. A constriction in the model above the position of the vocal chords seems to correspond with a possible action of the false vocal chords, but the observations on this point are not yet conclusive.

In a further series of experiments (with R. S. Clay) a 1-in. bore rubber tube 15 cm. long (in the clear) was used as the resonator and an adjustable tube clip for producing the upper constriction, the lower constriction (corresponding with that of the vocal chords) being produced by a slit in a plug of plasticene and the unphonated sounds by air from a compression plant passed through the model. By complete or partial closure and release of the tube in various positions it is found possible to produce p, f, s and k, or b, v, z and g, by adjusting the clip so as to give a slit aperture of 16 mm. for the p–k series or 6 mm. for the b–g series. T. H. P.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

1828. *Electromagnetic Field.* **U. Crudeli.** (Accad. Lincei, Atti, 4. pp. 373–376, Nov. 7, 1926.)—A particular case fully considered in which the electric (or the magnetic) field is constantly null at the contour while the magnetic (or the electric) field is tangential to the contour. A. D.

1829. *Electromagnetic Theory and the New Undulatory Mechanics.* **L. de Broglie.** (Comptes Rendus, 184. pp. 81–82, Jan. 10, 1927.)—A mathematical discussion, with reference to Bateman's recent note (Nature, 118. p. 839, Dec. 11, 1926), on the possibility of establishing agreement between the electromagnetic theory and the new undulatory mechanics. It is possible that the classical values of the potentials and of the fields may be only the mean values of the real magnitudes. J. J. S.

1830. *Dynamical Theory of the Electromagnetic Field.* **J. C. Maxwell.** (Nature, 119. pp. 125–127, Jan. 22, 1927. Abstract of Reprint from the Roy. Soc. Proc. of Dec. 8, 1864.)—The theory seeks for the origin of electromagnetic effects in the medium surrounding the electric or magnetic bodies, and assumes that they act on each other through the intervention of this medium. Part of the paper is devoted to the mathematical expression of the electromagnetic quantities referred to each point in the field, and to the establishment of the general equations of the electromagnetic field which express the relations among these quantities. Light, according to the electromagnetic theory, consists of alternate and opposite rapidly recurring transverse magnetic disturbances accompanied with electric displacements, the direction of the electric displacement being at right angles to the magnetic disturbance, and both at right angles to the direction of the ray. The theory does not attempt to give a mechanical explanation of the nature of magnetic disturbance or of electric displacement; it only asserts the identity of these phenomena as observed in magnetic and electric experiments with what occurs in the rapid vibrations of light in a portion of time inconceivably minute. J. J. S.

1831. *Answer to J. Mattauch's Reply to Criticism of his Paper on the Existence of Sub-Electrons.* **F. Ehrenhaft.** (Zeits. f. Physik, 41. 8–9. pp. 708–709, 1927.)—This note deals briefly with the points in dispute [see Abstracts 2658 and 2659 (1926)], since these have been already considered at length in the papers of Reiss [see Abstract 1096 (1927)] and Trebitsch [see Abstract 532 (1927)]. It is pointed out that Mattauch's measurements with mercury particles do not support his argument owing to their incompleteness. The most important criticism (*viz.*, that the measurements of e/A fluctuate by more than 100 %) remains uncontradicted. H. H. Ho.

1832. *The Magnetic Moment of the Electron.* **L. Brillouin.** (Comptes Rendus, 184. pp. 82–84, Jan. 10, 1927.)—The possibility of directly investigating the magnetic moment of the electron or the magneton of Bohr, by observing the behaviour of a bundle of electrons in a magnetic field, is discussed. J. J. S.

1833. *The Electron as a Vector Wave.* **C. G. Darwin.** (Nature, 119. pp. 282–284, Feb. 19, 1927.)—Certain objections can be advanced against the conception of the spinning electron both on grounds of form and of unnecessary complication. Though the spinning electron has been shown to give doublet spectra correctly, it has been found impossible to derive the solutions in a rigorous Hamiltonian form. The wave mechanics leads to the idea of associating the electron with a vector wave which will give the factor 2, which appears essential in order to give the required number of states. A theory is developed which is satisfactory for a single electron but presents certain difficulties when more than one electron is present. A. Wh.

1834. *Variable Mass of the Electron.* **L. T. Jones.** (Phil. Mag. 3. pp. 622–624, March, 1927.)—The mass of the electron is not a function of the velocity alone, but also a function of the potential. The mass of the electron is always measured at the potential of the observer, and the slow-velocity mass inherently can never be measured by deflexion methods while at a high potential relative to him. If the mass of only the negative charge is a fraction of its potential, this should be evidenced by the greater gravitational attraction of a metal mass at potential V. If the masses of both the proton and the electron are a function of their potential the effect will be nil. The equivalence of energy and mass has not been verified except through the variable mass of the electron. J. J. S.

1835. *Electric Field of a Charged Wire and a Slotted Cylindrical Conductor.* **C. Snow.** (Bureau of Standards, Sci. Papers, No. 542. pp. 631–646, 1926.)—The potential U, at any point $z = x + iy = re^{i\theta}$ in the xy plane, is found which is due to a line charge Q at the origin, perpendicular to the xy plane, in the presence of a certain outer shield at zero potential. This shield consists of a cylindrical shell of no radial thickness having the line charge for its axis, whose trace on the xy plane is that part of the circular arc $r = a$, whose angle θ lies between the limits $-p$ and p, where p is a positive angle less than π. This potential is given as the real part of the expression

$$U + iV = Q \log \frac{(z-a)\cos^2 p/2 + (z+a)\sin^2 p/2 + \sqrt{(z-ae^{ip})(z-ae^{-ip})}}{-(z-a)\cos^2 p/2 + (z+a)\sin^2 p/2 + \sqrt{(z-ae^{ip})(z+ae^{-ip})}}$$

where the radical denotes that branch whose real part is positive when the point z is external to the circle. The surface density σ of the induced charge at a point θ on the charged arc is found from the above equation to have the value

$$\sigma = -\frac{Q}{4\pi a}\left\{\frac{1}{\cos p/2\sqrt{\tan^2 p/2 - \tan^2 \theta/2}} \pm 1\right\},$$

the upper sign corresponding to the inner density (on the concave side), the lower to the outer. The outer density vanishes with the closing of the circle, *i.e.*, when $p = \pi$. J. J. S.

1836. *Electrostatic Capacity of Aluminium and Tantalum Anode Films.* **N. A. de Bruyne** and **R. W. W. Sanderson.** (Faraday Soc., Trans. 23. pp. 42–51, Jan., and Disc., pp. 107–108, March, 1927.)—Using a bridge method of measurement at audio-frequencies, an experimental study is made of the electrostatic capacity of Al and Tl anode films and of the variation of equivalent shunt capacity and resistance with frequency. It is shown conclusively that if an electrolytic condenser be assumed equivalent to a network of simple and calculable form, the values of the constituent parts of that network are not independent of frequency. No simple network can be found which is an exact equivalent, though there is probably an infinite number of more complex networks possible. Thus no exact physical significance, such as measurement of film thickness, can be attached to any values of capacity which may be obtained. It is found that the reciprocal of the capacity of an Al anode increases to a steady value according to an approximately logarithmic law of growth. A. B. C. L.

1837. *Specific Inductive Capacity of Heterogeneous Mixtures.* **J. Errera.** (Comptes Rendus, 184. pp. 455–458, Feb. 21, 1927.)—The specific inductive capacity of powdered KCl is proportional to its bulk-density. When the powdered salt is compressed to equal density it has the same s.i.c. as the crystal. Lead chloride and nitrate show a similar linear relation between bulk-density and specific inductive capacity, but the lines plotted by the author extrapolate to about 0·5 and 0·8 bulk-density at zero s.i.c., instead of to zero; and the value of the specific inductive capacity of lead chloride, when compressed to the density of the crystal, is 28, where Aenert gives the value 42, but for a different frequency. T. M. L.

1838. *Demonstration of the Behaviour of Bodies with Non-Conducting Surfaces in Electrostatic Fields.* **L. G. Vedy.** (Phys. Soc., Proc. 39. pp. 169–170, Feb. 15, 1927.)

1839. *Direction of the Current in Lightning.* **H. Maurer.** (Phys. Zeits. 28. pp. 211–212, March 1, 1927.)—The conclusion reached by A. Wigand [Abstract 1489 (1927)] that lightning generally carries a negative current from cloud to earth is based on land observations, whereas the comparatively few nautical observations recorded show that compasses in front of the vertical path of a flash reveal the effect of a magnetic north pole and those behind it of a south pole. This indicates a positive current from cloud to earth. If confirmed by future observations, which are very desirable, this experience would show that the prevailing direction of the current over land is the opposite of that at sea. Considering the great extent of the oceans, this is not in keeping with Wigand's view that the negative earth charge is maintained by lightning. E. F.

DISCHARGE AND OSCILLATIONS.

1840. *Luminous Discharge through Rare Gases.* **R. Whiddington.** (Roy. Inst., Proc. Advance Proof. Received Sept., 1926.)—When a current from a storage battery is passed through a vacuum tube containing argon or neon at low pressures, the discharge presents the usual ordinary appearance of positive column to the eye. When viewed in a rotating mirror, the luminosity is seen to be regularly intermittent, consisting of brilliant coloured flashes moving quickly down the tube from anode to kathode. The speed of these flashes is inversely proportional to the pressure of the gas, is determined to some extent by the value of the current, but is not much affected by the applied potential. When the gas is impure the flashes are non-uniform, sometimes evidenced by a general wavy appearance in the mirror, sometimes by two clearly differentiated sets of flashes of differing speeds in two parts of the tube. Possible theories of this new type of discharge are mentioned, and its relation to the well-known discharge phenomena is discussed. A. E. G.

1841. *A New Effect in the Anomalous Glow Discharge.* **A. Güntherschulze.** (Zeits. f. Physik, 40. 6. pp. 414–419, 1926. From the Reichsanstalt.)—In the normal glow discharge as the anode is brought towards the kathode and enters the Faraday dark space, the p.d. drops rapidly, since primary electrons are reaching the anode. As the distance is further diminished, the p.d. remains fairly constant, and finally rises fairly sharply again. In the anomalous glow discharge, when the same operation takes place, the p.d. drops sharply, but immediately commences to rise sharply again, and this recovery is more sudden the higher is the impressed voltage. This is taken to show that the primary electrons are able to produce more ions by impact on the gas and water vapour adsorbed on the anode than on the free gas. The explanation given is able to help in the elucidation of the " pseudo-high vacuum," especially at very low pressures. At higher pressures it is mainly due to the influence of the walls. A. C. M.

1842. *Influence of Ultra-Violet Light on the Glow Discharge.* **E. Salzwedel.** (Ann. d. Physik, 82. 3. pp. 305–345, Feb. 8, 1927.)—A normal form of the glow discharge can exist under suitable conditions even with small strengths of discharge current. The illumination of the kathode with ultra-violet light produces changes which may consist in a raising or lowering of the discharge current. The illumination effect is in its nature independent of the gas and the material of the electrode. The changes of current are connected with changes of the distribution of potential in the path of the discharge and in the outer portions of the current region. The magnitude of the changes in the discharge produced by illumination of the kathode is dependent on the intensity of the incident light. J. J. S.

1843. *Potentials in a Discharge through Gases at Low Pressures.* **K. G. Emeléus.** (Cambridge Phil. Soc., Proc. 23. pp. 531–541, Jan., 1927.)—A steady discharge in a tube fitted with plane aluminium electrodes is employed. The anode is fixed with respect to an exploring electrode which takes the form of an annular ring of platinum wire flush with the sides of the cylindrical tube. The kathode is movable. Langmuir's method of determining the potential is employed, the current to the exploring electrode being measured as its potential is varied. Air, oxygen, nitrogen and hydrogen have been used with pressures from 0·1 to 0·4 mm., current densities from 0·02 to 0·2 mA/cm.^{2} and applied potentials from 300 to 700 volts. At the low pressures the potential difference is almost entirely across the kathode dark space but at the higher ones a drop of 40 volts may exist across the remainder of the discharge. Reversal of the field is noted in some cases in the negative glow and in the Faraday dark space. A. Wh.

1844. *Low-Pressure Electric Discharge in Intense Electric Fields.* **C. del Rosario.** (Frank. Inst., J. 203. pp. 243–250, Feb., 1927.)—Several investigations have been made on the emission of electrons by metals in intense electric fields, such as those of Lilienfeld, of Millikan and Eyring [see Abstract 1437 (1926)], and of Gossling. Schottky, from theoretical considerations, calculated the field intensity required to pull out electrons from a metal surface and concluded that it is of the order of 10^8 volts/cm. The fields actually used in the experiments, however, were only 10^{-3} to 10^{-2} of this value. Millikan and Eyring advanced as a probable explanation for the difference the geometrical roughness, or some chemical impurity on the metal surface. The present work is undertaken to find out, among other things, the effect on the electron emission of the residual gases and the applied potential difference as distinct from the field intensity. The experimental methods are described in detail and illustrated with diagrams. A. E. G.

1845. *A New Arrangement for Measuring Cooling Effects.* **H. Rothe.** (Zeits. f. Physik, 41. 6–7. pp. 530–534, 1927.)—A new arrangement is here described with which it is possible to determine with greater accuracy than hitherto the exchange of heat which takes place owing to the thermic emission of charged particles. The cause of the abnormal cooling effects previously observed by the author in the space-charge region with an oxide-kathode is explained. The possibility of further measurements with oxide-kathodes is discussed. A. E. G.

1846. *Theory of the Kathode Dark Space.* **R. Seeliger.** (Zeits. f. Physik, 41. 6–7. pp. 535–547, 1927.)—The present paper forms a reply to the remarks published by Güntherschulze [see Abstract 1491 (1927)] on the author's previous article dealing with the theory of the kathode dark space [see Abstract 763 (1927)]. A. E. G.

1847. *Pure Metal Electrodes in Electric Discharge Tubes.* **J. Taylor.** (Journ. Sc. Instruments, 4. pp. 78–80, Dec., 1926.)—Sodium may be introduced into metal filament lamps by utilising a discharge between the heated filament and the glass walls which are partially immersed in a bath of molten sodium nitrate at about 350° C. Introducing sodium in this way into neon lamps improves their use for capacity and high resistance measurements. A capacity as low as 0·001 mfd. can be measured. For parallel electrode tubes the sparking potential decreased to a constant minimum value as the amount of sodium was increased. Experiments with pure tungsten electrodes in argon showed that the first discharge passed less readily than succeeding ones. The higher sparking potential did not reappear when the tube had been rested. The decrease is due to the absorption of gas by the kathode. The value of the first sparking potential is alone definitely characteristic of the metal comprising the electrode. R. G. J.

1848. *Sparking Potentials of Glow Discharge Tubes.* **J. Taylor.** (Phil. Mag. 3. pp. 368–382, Feb., and Supplement, 3. pp. 753–770, April, 1927.)—In the first paper a definition of the static sparking potential is given and the luminous discharges that flow through a discharge-tube prior to the actual spark or "flash" are discussed. The volt-ampere characteristics for small currents of the order of 10^{-6} and 10^{-7} amps. are discussed and some examples given for discharge-tubes consisting of circular parallel electrodes 15 mm. apart, and filled with neon-helium gas mixture. These characteristics are termed "corona" characteristics. The idea of threshold currents is described, and it is shown that corresponding to each current through the discharge tube there is a definite sparking potential which diminishes as the current is increased. The threshold-current-sparking-potential function is shown to be the same as the "corona" characteristic. Some electrical double layer effects on the electrode surfaces are described. It is shown, by the introduction of sodium on to the electrodes by electrolysis through the glass of the discharge tube, that the sparking potential values alter very considerably with the nature of the kathode.

In the second paper the electrode surface effects of discharge tubes and their relation to the sparking potentials is dealt with. It is shown in the case of tubes containing neon-helium mixtures as filling gas and having electrodes of nickel and iron that there is a temporary increase of the sparking potential with " flashing " or discharge. This increase of sparking potential, termed " polarisation," is considered in detail. A new theory of the sparking potentials is given, in which it is assumed that electrons are given off from the kathode by the photoelectric effect of the radiation from the positive ions which are neutralised at the kathode surface.

A. E. G.

1849. *Sparking Potentials of Discharge Tubes Containing Carefully Purified Electrodes.* **J. Taylor.** (Roy. Soc., Proc. **114.** pp. 73–84, Feb. 1, 1927.)—This paper describes results obtained in a continuation of work carried out on the electrode surface phenomena of discharge tubes in their relation to the sparking potential function [see preceding Abstract]. A description is given of experiments on the sparking potentials of a discharge tube containing a filling gas of argon and comprising a tungsten wire electrode surrounded by a coaxial tungsten wire spiral electrode, both of which could be purified by heating electrically *in vacuo* or in argon. Experiments with " sodiumated " electrodes are also described. The conclusions are: the sparking potential is a function of the nature and condition of the kathode surface and varies continuously with changes of the latter, depending upon the mean composition of the " working " part. It is higher for the first discharge between " vacuum-formed " tungsten electrodes, falls to a minimum with continued discharge, and then increases again to a definite value. The results are interpreted as being due to the change of the photoelectric emissivity of the kathode due to changes in the surface gas layers. A theory of the sparking potential is given which for parallel-plate electrodes yield an exactly similar relation to that given by Townsend. $\gamma(\epsilon^{\alpha x_1} - 1) = 1$ γ, however, has a different significance; it represents the ratio of the number of electrons given off by the kathode by the photoelectric effect to the number of positive ions neutralised there. α is the average number of molecules of gas ionised by an electron in moving through a cm. in the direction of the electric force (X volts per cm.), and x_1 is the sparking distance. γ varies with the conditions of the kathode surface.

A. E. G.

1850. *Method of Cycles in the Thermodynamic Theory of Pure Electronic Emission.* **G. Filippini.** (N. Cimento, 3. 8. pp. 370–389, Dec., 1926.)—This is a theoretical discussion which endeavours to show that the theory of cycles leads to the introduction of a new and correct definition of the true latent heat, Q′, of evaporation of the electrons, and to furnish a precise expression of the same. It leads then to a new method of finding the value of q which is in complete agreement with that found by following other methods.

A. E. G.

1851. *Application of the Method of the Magnetic Spectrum to the Study of Secondary Electronic Emission.* **C. F. Sharman.** (Cambridge Phil. Soc., Proc. **23.** pp. 523–530, Jan., 1927.)—The present paper deals with the application of the method of the magnetic spectrum to the case of the secondaries excited by a primary electron beam. The following are the points of chief importance; (1) The production of vacua sufficiently good that no distortion of the spectrum occurs owing to the absorption of the slower electrons by the residual gas; (2) the reduction to a minimum of electron reflection from the sides of slits and the walls of the container; (3) the elimination of stray magnetic fields and the accurate control of the applied field, since the value of the field is an important factor in the form of the final energy distribution curve. The present method confirms the previous results obtained by means of the retarding potential method in showing that the total secondary emission consists of two distinct groups of electrons with entirely different properties. A. E. G.

1852. *The "Hetero-Normal" Current-Density Effect.* **W. Stephenson.** (Phil. Mag. 3. pp. 306–330, Feb., 1927.)—Refers to experiments of H. Schüler [see Abstract 1027 (1926)]. The author has published an introductory paper on the "hetero-normal" effect, and now describes an investigation of the subject by means of a discharge tube with two parallel disc kathodes, the diameter of which was almost equal to the internal diameter of the tube and one of which could be raised or lowered so as to vary the distance between them. The anode was in a side tube between the two discs. When the current is adjusted so that the kathode area is just completely utilised by the discharge the current density increases as the kathode surfaces are brought nearer to one another; in one experiment it increased from 7 to 1400 in arbitrary units when the distance diminished from 3 cm. to 0·3 cm., the necessary voltage only rising from 295 to 325 volts. The "hetero-normal" current density i and the thicknesses of the Crookes dark space d are connected by the equation id^2 = constant. The constant is independent of pressure, but is different for different gases. The "conductance" is constant for each distance between the kathode plates at any given pressure. H. N. A.

1853. *Ballistic Characteristics of the Photoelectric Cell.* **F. E. Null.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 73–85, Jan., 1927.)—As the result of the present investigation it is concluded that the quantity of electricity emitted by the photoelectric cell for single flash exposures is, for light of constant intensity, directly proportional to the length of the exposure. The quantity of electricity passed by the photoelectric cell for single flash exposures of constant length, but consisting of plane polarized light of different intensities, is directly proportional to the intensity of the light. A single pulse amplifier can be obtained by the use of a bucking battery, that will give linear amplification for pulses of current whose length varies over a range of from 1/10 sec. to approximately 6/10,000 sec. The photoelectric method of camera shutter calibration is convenient and accurate. The photoelectric cell provides a means for distinguishing between the wave and quantum theories. A. E. G.

1854. *Quantum Theory of the Normal Photoelectric Effect.* **D. Nasledow.** (Phys. Zeits. 28. pp. 149–151, Feb. 1, 1927.)—In this paper the existence of a transversely directed impulse of the light quantum is assumed and the author deduces the expression for the angle of emission of the photoelectron which was found by Bothe [see Abstract 2518 (1924)] in quite another way and experimentally confirmed. This transverse impulse of the light quantum can also be used for the explanation of the polarisation phenomenon. J. J. S.

1855. *Photoelectric Emission as a Function of Composition in Sodium-Potassium Alloys.* **H. E. Ives** and **G. R. Stilwell.** (Phys. Rev. 29. pp. 252–261, Feb., 1927.)—The entire series of alloys of sodium and potassium have been investigated with respect to the relative values of the photoelectric currents produced by light polarised with the electric vector in and at right angles to the plane of incidence. The pure metals when molten exhibit values below three for the ratio of the two emissions; the alloys show three maxima at compositions approximately 20, 50, and 90 atomic per cent. of sodium, with values from 10 to 30 for the ratio; the minima between show low values approximating those for the pure metals. The maxima and minima of the ratio of emissions are due to complicated variations in magnitude of the two emissions compared. AUTHORS.

1856. *Photoelectric Activity of the Silver Halides and Silver Sulphide.* **F. C. Toy, H. A. Edgerton** and **J. O. C. Vick.** (Brit. Phot. Research Assoc. Lab. Comm. No. 58. Phil. Mag. 3. pp. 482–495, Feb., 1927.)—The correlation of the photoelectric and photographic properties of silver halides is investigated. In the case of silver halides prepared by fuming metallic silver or by subsequent fusing, the order of photoelectric sensitivity is iodide > bromide > chloride. The order is probably the same when the salts are precipitated from aqueous solutions. Silver sulphide, prepared by fuming metallic silver with hydrogen sulphide is two to three times as active photoelectrically as silver iodide similarly prepared, and about twenty-five times as active as silver bromide. Traces of silver sulphide or silver iodide in silver bromide do not affect the photoelectric sensitivity abnormally. A small percentage of iodide in bromide does not produce any appreciable shift of the critical photoelectric wavelength towards the visible region of the spectrum, comparable with the chromatic sensitisation observed photographically. The results indicate that there is no parallelism between the true photoelectric and photographic properties of the silver halides. J. S. G. T.

1857. *Theory of Photo Effects.* **G. Beck.** (Zeits. f. Physik, 41. 6–7. pp. 443–452, 1927.)—The behaviour of an atom in the field of an electromagnetic wave is here investigated. According as the frequency of this wave is less than or exceeds the frequency of the series tops, dispersion or photo effect appears. The Einstein equation is valid for the kinetic energy of escaping electrons. It is further possible, in the first approximation, to make a declaration on the distribution in space of the photoelectrons. Finally, it gives a free interpretation of the Wiener research with standing waves, without it being necessary to make any other assumption, respecting the kind of procedure in the light sensitive layer, than that it treats with quantum processes. [See also Abstract 55 (1927).] A. E. G.

1858. *The Velocity Distribution of Electrons Issuing from Small Holes.* **R. H. Dalton** and **W. P. Baxter.** (Phys. Rev. 29. pp. 248–251, Feb., 1927.)—The velocity distribution of a beam of 50-volt electrons issuing from a hole 0·022 cm. in diameter in a copper plate 0·02 cm. thick has been measured. Seventy per cent. of the electrons were found to retain approximately their initial velocity. By coating the sides and edges of the hole with lamp black 95 % of the electrons were transmitted without appreciable energy loss. Similar results were obtained with grids of 100 mesh copper gauze. AUTHORS.

1859. *Electron Scattering in Helium.* **E. G. Dymond.** (Phys. Rev. 29. pp. 433–440, March, 1927.)—An apparatus is described in which both the velocity and the angular distribution of electrons which have suffered single collisions in a gas are examined. It is found in helium that, for initial velocities of 100 volts and over, the principal energy loss is due to the excitation of the 2^1S state, corresponding to 20·5 volts. No loss corresponding to 19·7 volts is found for these velocities. For still higher velocities it seems probable that the energy interchange ceases to be quantised, and that the atom is capable of absorbing temporarily more energy than is required for excitation. The angular distribution of electrons which have lost 20·5 volts energy in colliding shows very marked maxima, the predominant one being in the forward direction. The bearing of the Schrödinger wave mechanics on this point is discussed. [See also Abstract 191 (1927).] AUTHOR.

1860. *Ionisation and Resonance Potentials in Gallium and Indium.* **C. W. Jarvis.** (Phys. Rev. 29. pp. 442–450, March, 1927.)—The critical potentials of gallium and indium have been experimentally determined by the method of inelastic impact. A simple three-electrode tube and the Hertz differential tube as a simple three-electrode tube or as a four-electrode tube were used. Ionisation was detected by the modified space charge method, by the Lenard method, and by the change in the gap resistance. The following critical potentials below ionisation were observed: in gallium vapour 3·07 volts, $(2p_2-2s)$; 4·22 volts, $(2p_2-3d_2)$; 2·70 volts, $(2p_1-2s)$; 3·8 volts, $(2p_1-3d)$; in indium vapour 0·30 volts, $(2p_2-2p_1)$; 3·03 volts, $(2p_2-2s)$; 4·07 volts, $(2p_2-3d_2)$; 2·8 volts, $(2p_1-2s)$. Two ionisation potentials were observed: in gallium vapour 5·8 and 13·2 volts; in indium vapour 6·3 and 14·1 volts. The ionisation potentials are judged to be accurate to 0·5 volt. AUTHOR.

1861. *The Propagation of Electromagnetic Waves round the Earth.* **H. Gutton** and **J. Clément.** (Comptes Rendus, 184. pp. 676–678, March 14, 1927.)—The authors suggest, on the basis of laboratory experiments, that a mean frequency of oscillation of the ions characterises ionisation of the lower strata of the Heaviside layer. When short waves are propagated in the layer, the frequency of the electromagnetic field is greater than that of the ionic oscillations. The convection current produced by movement of the ions is accordingly opposite in phase to the displacement current and the dielectric constant is apparently reduced. For long waves, convection and displacement currents are in quadrature. For still longer waves the respective currents are in phase and the dielectric constant is apparently increased. Propagation of such waves to great distances is effected by the oceans. J. S. G. T.

1862. *The Direction of the Rectified Current in Crystal Detectors.* **A. Schleede** and **H. Buggisch.** (Phys. Zeits. 28. pp. 174–179, Feb. 15, 1927.)—The authors discuss the inconstancy of the sensitivity of crystals, and the direction of the rectified current by the employment of high voltages, due to heating of the contact point, and to the shape of the characteristic. The characteristics of a number of crystals are taken, including natural galena, artificial lead-sulphide crystals, and pyrites, and the method by measurement using voltages from 20 to 200 millivolts given. Within these limits, the rectified current of a given crystal combination always has the same direction, which is characteristic of it. With galena, the current flows from the metal point to the crystal, and with pyrites, the reverse. The combination galena-galena is shown to be not a detector. E. T. A. R.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1863. *Numerical Data of Electricity, Magnetism, and Electrochemistry.* **A. Buffat, G. I. Higson, K. Gordon** and **M. Malapert.** (Tables Annuelles de Constantes et Données Numériques, Paris, 5. pp. 783–1270, 1926. Extract.)—In this new edition of tables of constants in Electricity are given amongst other additions data on the influence of pressure and of traction on certain electric resistivities, on the effect of light on the conductivity of certain liquids, and some on the influence of pressure on the electric and thermoelectric phenomena of contact. J. J. S.

1864. *The Electrical Resistance of a Stranded Conductor.* **W. E. Alkins.** (Manchester Phil. Soc., Proc. 70. pp. 37–40, 1925–1926.)—The assumption that in a stranded conductor the individual wires are practically insulated from each other was carefully tested in the case of a conductor composed of seven hard-drawn copper wires. The theoretical resistance of the strand of seven wires in parallel, assuming that the metallic contact between the constituent wires is without influence upon the resistance of the conductor, was 0·10407 ohm at 60° F. The value obtained by direct determination was 0·1040 ohm. The difference is within the limit of the experimental error of the resistance measurements, and it may be concluded that the influence of the metallic contact between the individual wires upon the resistance of the stranded conductor is negligible. J. J. S.

1865. *Resistance of Copper Wires at Very High Frequencies.* **W. M. Roberds.** (Phys. Rev. 29. pp. 165–173, Jan., 1927.)—At frequencies of the order of 10^7 cycles the distributed capacity of single loops of wire may cause sufficiently unequal current distribution in the loop to account for large apparent discrepancies between observed and calculated resistances. For a given frequency, more uniform current distribution is gained by decreasing the size of the loop and simultaneously increasing the capacity of the tuning condenser. Curves are plotted with ratio of observed to calculated resistance as ordinate and condenser setting as abscissa. For No. 20 copper wire at $0{\cdot}86 \times 10^7$ cycles the ratio decreases to at least 1·05 as the current distribution along the wire is made more and more nearly uniform. For No. 16 oxide coated copper wire the ratio reduces to at least 1·35. The discrepancy in both cases is accounted for by the same value of condenser resistance. Observed resistance of a given loop is shown to vary greatly as condenser resistance is changed. Curves are run at $1{\cdot}5 \times 10^7$ cycles on No. 20 bright copper wire, No. 20 oxide coated copper wire, and No. 20 silver wire. For all curves the ratio fell well below 1·45, and was still decreasing as far as data were taken. Since curves run on bright copper wire coincide with curves run on exactly the same wire after it had gained a heavy coating of oxide, it can be definitely stated that the presence of oxide has no appreciable effect on the resistance. AUTHOR.

1866. *Matthiessen's Law.* **W. Geiss** and **J. A. M. v. Liempt.** (Zeits. f. Physik, 41. 11–12. pp. 867–871, 1927.)—Matthiessen's law for alloys (specific resistance × the temperature coefficient of the electric resistance = const.) applies also to worked metals (tungsten, molybdenum, nickel, platinum). A. D.

1867. *Hall Effect in Bismuth with Small Magnetic Fields.* **C. W. Heaps.** (Phys. Rev. 29. pp. 332–336, Feb., 1927.)—The Hall coefficient for a bismuth plate of dimensions 0·011 × 0·9 × 2·0 cm. has been measured for magnetic fields ranging from 0·07 to 2·40 gauss. The average value of the Hall coefficient R in this range was 11·5, and variations of R due to change of field strength in this range were less than experimental errors. For larger fields the Hall coefficient of this specimen decreased from 13·5 for a field of 650 gauss to 5·9 for a field of 8600. It is concluded that for similar ranges of field the data reported by P. H. Craig [see Abstract 2182 (1926)] are erroneous, probably because of insulation leakage or uncompensated thermomagnetic effects. A simple method of making very thin bismuth plates is described. AUTHOR.

1868. *Benedicks and Knudsen Effects.* **W. Burstyn.** (Zeits. techn. Physik, 8. 1. pp. 26–27, 1927.)—On heating the junction between a wide and a very narrow cross-section of a conductor an e.m.f. (Benedicks effect) is produced if the conductor is a metal wire; a pressure difference (Knudsen effect) is produced if the conductor is a gas-filled tube. Both effects are analogous to each other according to the electron theory of gases. J. J. S.

1869. *Thermionic Theory of the Electrical Conductivity of Dielectrics.* **H. Saegusa.** (Tôhoku Univ., Sci. Reports, 15. pp. 795–803, Dec., 1926. Paper read before the Annual Meeting of the Math. Phys. Soc. Japan, April, 1926. In English.)—Assuming that the electrons by which the electrical conduction in a dielectric is carried out are of thermionic origin the number of these electrons in unit volume is given by Richardson's formula in the case of thermionic emission. From consideration of the recombination of the electrons with the parent ionised atoms the number of electrons which actually convey the electronic conduction was deduced, and thus an expression for the electrical conductivity as a function of temperature and of material constants was obtained. This expression showed satisfactory agreement with the author's former experimental results for quartz. J. J. S.

1870. *Conduction of Electricity in Solid Dielectrics at High Strengths of Field.* **H. Schiller.** (Archiv f. Elektrot. 17. pp. 609–624, Jan. 31, 1927.)—A review is given of former researches on the passage of current through glass and mica with high field strengths, and the results obtained by different investigators are compared with each other. The connection of the specific resistance with the field strength is well expressed for a field strength interval of 1×10^6 volt/cm. by a relation given by H. H. Poole, *viz.*, $K = a + bX$, where K is the conductivity, X is the field strength, and a and b are constants. On extension over a greater range evident deviations are shown. The relation between temperature and resistance for glass stated by Rasch and Hinrichsen, $\log \rho = A'/T + B'$, holds also for high field strengths. Researches on the electrolysis of glass at high field strengths and room-temperature gave a quantitative confirmation of Faraday's law. From the experimental results consequences are deduced for the penetration of solid dielectrics. J. J. S.

1871. *Use of the Theory of Integral Equations for the Problem of Penetration of Solid Insulators.* **A. Kneschke.** (Zeits. f. Physik, 41. 2–3. pp. 195–210, 1927.)—With the help of an integral equation the heat conducting process which forms the basis of the comprehension of penetration as set forth by K. W. Wagner is here represented. It gives the penetration field strength as function of the smallest specific value of the nucleus of this equation. The behaviour in quasi-homogeneous and inhomogeneous materials is investigated both under constant and variable front surface temperature, and the potentials of penetration as a function of the physical constants of matter are shown. A. E. G.

1872. *Dielectric Constants in Conducting Electrolyte Solutions.* **H. Hellmann** and **H. Zahn.** (Ann. d. Physik, 81. 7. pp. 711–756, Nov. 5, 1926.)—The authors follow up a previous article [see Abstract 783 (1927)] with a full paper on experimental details. They find electrolytes to be divisible into two groups; those (HCl) which even at high concentrations show little lowering of the dielectric constant; and those ($CuSO_4$) which show this effect even at low concentrations. A. D.

1873. *The Electric Moments of Disubstituted Benzene Derivatives.* **R. N. Kerr.** (Phil. Mag. 3. pp. 330–336, Feb., 1927.)—J. J. Thomson has suggested that these moments may vary with the positions of the substituents. The sign of the electric doublet introduced when H is displaced depends on the nature of the substituent, and this may be one of two types: (1) halogens, OH, NH_2, CH_3; (2) NO_2, COOH, CHO, CN. In type (1) the + end of the doublet will be toward the rest of the molecule and in type (1) the − end. If both substituents are of the same type, the moments of the isomers will be in the order $o > m > p$, but if they are of different types the order will be $o < m < p$, this should affect the dielectric constants in a similar manner [see Abstract 155 (1924)]. The author has determined a number of dielectric constants of disubstituted liquid benzene derivatives. The isomers in all cases show a gradation from *o* through *m* to *p*, with an increase in some cases and a decrease in others. J. J. Thomson's theory holds when both substituents are the same, but when they are different it is incorrect in several cases. H. N. A.

1874. *Dielectric Constant of Bromine. Part II.* **A. Bramley.** (Frank. Inst., J. 203. pp. 251–260, Feb., 1927.)—Using an electrostatic method, a study is made of the variation of the dielectric constant ϵ of bromine vapour with pressure, temperature and electric intensity. The curves obtained by plotting $\epsilon - 1$ against pressure for constant temperature and potential gradient are concave upwards at 23·9° C., rectilinear at 28·5° C., and concave downwards at 80° C. For the linear curve taken at 28·5° C. no effect is obtained by changing the field from 58 to 285 volts, but for those measured at 80° C. approx. a considerable variation is observed which depends on the pressure of the vapour. Values of the dielectric constant measured for a mixture of air and bromine vapour give results which confirm the additive law. A series of measurements is carried out on the absorption of Br_2 between $0 \cdot 80\,\mu$ and $2 \cdot 0\,\mu$ since no data were obtainable in this case. The data taken from these measurements show a broad absorption band in Br_2 vapour, beginning at 0·95 and extending to 1·5, which confirms the theory given in this paper of the phenomena.

A. E. G.

1875. *Dielectric Constants of some Gases.* **H. J. v. Braunmühl.** (Phys. Zeits. 28. pp. 141–149, Feb. 1, 1927.)—The variations with temperature of the dielectric constants of certain gases were investigated. Tables of results are given for the gases dealt with : H, Ar, Co, Co_2, N_2O, H_2S and HCl. The indications of polarity or non-polarity of the molecule in the various cases are also given. J. J. S.

1876. *Dielectric Properties of Ionised Gases.* **H. Gutton** and **J. Clément.** (Comptes Rendus, 184. pp. 441–443, Feb. 21, 1927.)—The dependence of the dielectric constant of hydrogen upon the degree of ionisation of the gas is investigated experimentally. At low pressures and with weak ionisation the dielectric constant is apparently less than 1.

J. S. G. T.

1877. *Determination of the Dielectric Constant of Air by a Discharge Method.* **A. P. Carman** and **K. H. Hubbard.** (Phys. Rev. 29. pp. 299–308, Feb., 1927.)—Two air condenser systems, one containing the test condenser and the other the balancing condenser, are charged to equal opposite potentials, the opposite charges are mixed and discharged through a galvanometer. The two condenser systems are adjusted until the galvanometer deflection is zero. A special form of rotating commutator was devised for which the contact resistances are small and uniform. This commutator has three pairs of make and break contacts, two for charging and discharging the two condensers, and one pair connected so that a single battery is used to charge both condensers. The capacity of the test condenser is obtained in terms of readings on a condenser which forms part of the balancing system. The ratio of the capacities of the test condenser, with a vacuum and with air for dielectric is then obtained. The calibration for the readings is described. This calibration is made with the apparatus in place, by simple changes of connections. Possible errors from time lag, thermal expansions, and deformations from pressure changes are discussed. The average of thirteen separate measurements gives 1·000594 for the dielectric constant of air at 0° C and 760 mm. Hg pressure. The thirteen separate readings agree in the second significant figure of the decimal part of the result. AUTHORS.

1878. *Nature of Dielectric Losses.* **K. Sinjelnikoff** and **A. Walther.** (Zeits f. Physik, 40. 10. pp. 786–803, 1927.)—A theory of dielectric losses is deduced from the experimentally determined electrical conductivity of insulators and the breakdown potentials of particular insulators. The theory proposed explains the experimentally found dependence of frequency and temperature, and in addition renders it possible to calculate the absolute value of the dielectric losses. The losses are calculated from the Joule formula $W = \frac{V^2}{K}$. The method of measurement of the resistance W is given, and the Curtis relation between capacity and frequency is theoretically explained. A description is given of a specially constructed apparatus for the estimation of the losses by means of a ballistic galvano meter. The concrete mechanism of conductivity of insulators is explained in the light of the information given in the paper. S. G. B.

1879. *Method of Measuring Dielectric Losses in Condensers.* **P. A. Cooper.** (Phil. Mag. 3. pp. 625–638, March, 1927.)—A loss-measuring device for use at radio-frequencies is described. A suitable fixed resistance is used, with two condensers mounted on a common shaft in such a way that as the shaft is turned the capacity of one condenser increases at exactly the same rate as the capacity of the other decreases. The arrangement is similar to the double condenser used for tuning two separate circuits at the same time. Any change in the frequency of the circuit in which the device is used is avoided. J. J. S.

1880. *A Recording Dynamometer.* **K. Möller.** (Zeits. techn. Physik, 7. 12. pp. 616–618, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The arrangement of the Wheatstone bridge of most practical value is discussed. A dynamometer is described which, in conjunction with a Wheatstone bridge, can be made to give records at a distance. The application to motor-car problems is considered. G. A. S.

1881. *Borehole Surveying.* **H. Briggs.** (Roy. Soc. Edinburgh, Proc. 46. 2. pp. 223–229, 1925–1926.)—The problems of ascertaining the verticality of a borehole is important, and one of peculiar difficulty. An electrical apparatus, ingeniously employing the principle of the Wheatstone bridge, is described and figured. The apparatus consists of two parts connected by a cable. A transmitter, lowered into the borehole, consists of a dish of salt solution provided with four electrodes in the N., S., E., W. positions. Into the salt solution a small plummet dips. The receiver consists of a similar dish of solution. The observer dips a pointer into this solution, and this is suitably connected to a telephone receiver. The position of the plummet in the transmitter is found by the point in the receiver which gives minimum noise on the telephones. W. A. R.

1882. *A Universal Variometer for the Measurement of the Earth's Magnetism.* **H. Haalck.** (Zeits. Instrumentenk. 47. pp. 16–32, Jan., 1927.)—The instrument is designed for the accurate measurement of the three components of the earth's force. It is capable of determining very small variations, and can be used in the field. Actually it is a modification of Schmidt's field balance [see Abstract 1392B (1925)]. It consists of two magnets rigidly fastened at right angles supported by a knife edge. The control consists of two suitably placed permanent magnets. As the suspended system is not supported at its centre of gravity, its position depends on the strength of the earth's field. Full instrumental details are given, and the complete theory of the instrument is worked out. A. A. D.

1883. *Lecture Apparatus for Directly Measuring the Magnetic Field.* **G. Dupouy.** (Comptes Rendus, 184. pp. 375–378, Feb. 14, 1927.)—A simple form of gaussmeter, depending on the marked anisotropy of a crystal of iron carbonate (siderite), which is placed in a tube capable of being rotated round its own axis. The crystal is subjected to the couple proportional to the field, and to this couple is opposed a restoring couple by the torsion of a wire or a spiral spring. The apparatus is calibrated by comparison with a fluxmeter, and can be used as a demonstration apparatus. F. J. B.

1884. *The Input Impedances of Thermionic Valves at Low Frequencies.* **L. Hartshorn.** (Phys. Soc., Proc. 39. pp. 108–123, Feb. 15, 1927.)—It is shown that accurate measurements of input admittance (or of input impedance) under various conditions can be made by means of the Schering capacity bridge. The input circuit is regarded as being equivalent to a condenser with a definite phase angle ϕ, or "loss angle" $\delta = 90^\circ - \phi$, and the results are expressed by stating the effective capacity and value of $\tan\delta$ for each set of experimental conditions. A series of measurements made on an R valve is recorded, and it is shown that the results are in good agreement with the theoretical investigations of Miller and Nichols. The theoretical investigation has been extended to allow for the effect of dielectric losses in the valve, since these were found by experiment to be rather large and to have an appreciable effect on the capacity and phase angle of the input circuit. It is shown that the effective capacity may vary from about 10 $\mu\mu$ F. to 100 $\mu\mu$ F. for an R valve, and the phase angle may vary from about 80° leading to 126° leading, depending mainly on the load in the anode circuit. Values of phase angle greater than 90° correspond to a negative resistance or negative power factor, and occur when the load in the anode circuit is inductive. The variations of input capacity and phase angle with filament voltage, anode voltage, input voltage, and frequency are also investigated. AUTHOR.

ALTERNATING CURRENTS AND MAGNETISM.

1885. *Criticism of the General Alternating-Current Circuit of J. L. la Cour.* **S. Fryze.** (Elek. u. Maschinenbau, 45. pp. 126–132, Feb. 13, 1927.)—Further notes on a new method of attacking alternating-current problems, enlarging upon a previous article by the author [see Abstract 2340 (1924)]. E. O. T.

1886. *Constant Paramagnetism.* **Paule Collet.** (Comptes Rendus, 183. pp. 1031–1032, Nov. 29, 1926.)—Permanganate of potassium has to be added to bichromate of potassium and luteocobaltic chloride as a substance which in solution presents a constant paramagnetism independent of the temperature. These three substances are at variance with Curie's law. Solid permanganate gives the coefficient of atomic magnetisation of managnese as $56 \cdot 5 \times 10^{-6}$; the solution gives it as 62×10^{-6}. A. D.

1887. *The Constant of Paramagnetism for Pentavalent Vanadium.* **N. Perrakis.** (Comptes Rendus, 184. pp. 445–447, Feb. 21, 1927.)—From a study of several salts of vanadium it is found that the paramagnetism of the pentavalent element is independent of temperature. The atomic susceptibility is $44 \cdot 0 \times 10^{-6}$, which is lower than that found by Honda and Owen for metallic vanadium ($76 \cdot 5 \times 10^{-6}$). It is concluded that the constant of paramagnetism may, like the atomic moment, assume different values in the same atom. G. E. A.

1888. *The Magnetisation of Single Crystals of Iron.* **K. Honda** and **S. Kaya.** (Tôhoku Univ., Sci. Reports, 15. pp. 721–753, Dec., 1926. In English. Report No. 138 of the Research Inst. for Iron, Steel and other Metals.)—The present paper contains the complete results of the authors' investigations (partly published in Oct., 1925, and April, 1926, in Tôkyô) made on single crystals of iron prepared from a Swedish mild steel of known composition. The principal axes of the crystals having been determined by the method of X-rays, the magnetisation of rods was measured first, as a preliminary, a ballistic method being employed. The value of I_s was 1707, and residual magnetism is very small. Also the initial and maximum permeability increase and the hysteresis loss diminishes as the number of grains per sq. mm. increases. It is concluded that the hysteresis is mainly affected by an irregular distribution of molecular magnets on the grain boundaries. Three oblate ellipsoids were made from single crystals, their long axes being about 20 mm., and for these the components of magnetisation were measured. The magnetisation curves for the tetragonal, digonal and trigonal axes are almost straight up to I = 1400, 1000 and 900 respectively. These curves show two or sometimes three sharp breaks, and the value of I_s is 1717 in respective fields of 70, 650 and 450 gauss for the three axes. In the plane (111) the space lattice consists of a series of equilateral triangles; below 300 gauss the direction of the sides of the triangle is more magnetisable than that of the bisector of the triangle, but above this field the contrary is the case. The results are discussed in relation to the molecular theory of magnetisation of ferromagnetic crystals of Okubu and Honda (published in 1916). Many phenomena observed by the writers are satisfactorily explained by this theory. G. E. A.

1889. *Magnetostriction of Single Crystals of Iron.* **K. Honda** and **Y. Mashiyama.** (Tôhoku Univ., Sci. Reports, 15. pp. 755–776, Dec., 1926. In English. Report No. 139 of the Research Inst. for Iron, Steel and other Metals.)—The iron rods and flat ellipsoids [see preceding Abstract] formed from single crystals obtained by Edwards' method were tested for change of dimensions in the magnetic field. It holds for both rods and ellipsoids that the magnetic expansion along the tetragonal axis is always positive, and that along the trigonal axis is always negative. These results agree with those of Webster [see Abstract 861 (1926)]. The magnetic expansion in ordinary iron, consisting of microcrystals, is a differential effect of the expansion and contraction observed, due to the random distribution of the axes. The expansion of ordinary iron is small compared with that in single crystals. G. E. A.

1890. *Calculation of the Magnetic Susceptibility of NaCl from Data on the Intensities of X-Ray Reflections.* **E. S. Bieler.** (Roy. Soc. Canada, Trans. 20. 2. pp. 489–495, 1926.)—It is shown that curves of the distribution of electrons in the atoms of a diamagnetic substance can be used to calculate the susceptibility of the atoms. The method is applied to NaCl, based on the distribution curves of Bragg, James and Bosanquet [see Abstract 285 (1923)], and of A. H. Compton. There is fair agreement between the calculated and the observed susceptibilities. G. E. A.

1891. *Magnetic Quality in Crystals. Discrimination of, and Stability in, Magnetic Lattices.* **J. Forrest.** (Roy. Soc. Edinburgh, Trans. 54. 3. pp. 601–701, 1925–1926.)—Of this paper, which is extremely long and mathematical, it is only possible to give a very general outline. It is based upon theories originally indicated by Peddie [see Abstract 1445 (1912)]. Two recent papers by the present writer constitute in effect abstracts of the present work [see Abstract 610 (1926) and next Abstract]. When a crystal is magnetised the resultant intensity (which is in general oblique to the field) can be replaced effectively by parallel and transverse components. The transverse component is usually small in comparison with the parallel component. These two quantities can be measured experimentally, and the results compared with values calculated on the assumption that in a magnetised crystal there is a codirected system of regularly arranged magnetic doublets. The experimental work falls under two heads. The component of intensity parallel to the field was measured by the force on the crystal in a non-uniform field. The specimen hanging from the centre of a thin copper wire stretched horizontally was pulled downwards by the drag of the non-uniform field. This downward displacement was measured microscopically. The transverse component was found by hanging the crystal from a torsion wire between the poles of a magnet. The magnet was rotated about a vertical axis and the resultant twist of the specimen noted. The specimens were always suspended with selected crystallographic faces suitably oriented with respect to the field. These fields were of the order of 30,000 gauss. Crystals from all the seven systems were examined, and the results considered in detail. A mathematical discussion is given of the stability of the possible lattices. In particular in the cubic system, the face-centred lattice has the greatest stability, followed in descending order by the simple cube and the body-centred cube. The paper concludes with a discussion of twinning. A. A. D.

1892. *Magnetic Anisotropy of Cubic Crystals.* **J. Forrest.** (Phil. Mag. 3. pp. 464–476, Feb., 1927.)—The present paper is an extension of two previous ones [Abstract 610 (1926) and preceding Abstract]. The treatment is confined to the cubic system, and is intended to indicate that the doublet conception is sufficient to explain the known facts, and to show that there are possibilities in the theory other than discrimination of the magnetic lattice. The crystals dealt with are iron, sodium chloride, zincblende, calcium fluoride and copper. The analysis identifies the magnetic element with the atom, and supports the assumption of the inverse square law between magnetic poles in a crystal. It also indicates the relative smallness of the length of the doublet to the atomic distance. A. A. D.

1893. *Principal Magnetic Susceptibilities of Crystals.* **I. I. Rabi.** (Phys. Rev. 29. pp. 174–185, Jan., 1927.)—In order to eliminate certain sources of error inherent in the usual methods, the crystal is suspended in a solution in the magnetic field, and the susceptibility of the solution is varied and the orientation of the crystal adjusted till there is no motion of the crystal due to the field. The susceptibility of the crystal is then found from that of the solution. Fourteen crystals belonging to the monoclinic, double-sulphate, hexahydrate, isomorphous series were examined; of these eleven were paramagnetic. Tables are given, including the susceptibilities along the three axes, the number of Bohr magnetons as found by the Weiss method, and as calculated according to Pauli-Sommerfeld. The principal susceptibilities appear to depend almost entirely on the paramagnetic ion alone. [See also Abstract 989 (1924).] G. E. A.

1894. *Temperatures of the Magnetic Transformations in the System Iron-Sesquioxide of Iron.* **J. Huggett** and **G. Chaudron.** (Comptes

Rendus, 184. pp. 199–201, Jan. 24, 1927.)—Sesquioxide of iron was reduced by means of pure dry electrolytic hydrogen at about 500° C., and the water obtained was weighed, so that the amount of oxygen in the resulting mixture of oxides and of iron could be calculated. The temperatures of the observed anomalies in the curves obtained in a self-registering magnetometer are shown as ordinates in a diagram, the abscissæ showing the percentage of the oxygen originally present in the Fe_2O_3 which has been removed. The points corresponding to Fe_3O_4, to FeO and to Fe are marked in the diagram. With from 1·3 to 9 % of oxygen removed from the original Fe_2O_3 (*i.e.*, for mixtures of Fe_2O_3 and Fe_3O_4) there are two transformation temperatures, one 570° C. corresponding to Fe_3O_4, and the other 650° C. that of a saturated solution of Fe_3O_4 in Fe_2O_3. In the system Fe_3O_4–FeO the Fe_3O_4 point at 570° appears, and the diagram shows two dotted lines, which are due to magnetic anomalies, which indicate one the decomposition of FeO and the other the inverse reaction. For the system FeO–Fe the diagram shows the transformation point of iron at 765°, and dotted lines which show the commencement of the decomposition of FeO, the point of transformation of the Fe_3O_4 due to this decomposition, and finally the recombination of Fe and Fe_3O_4. H. N. A.

1895. *Magnetic Properties of Pyrophosphate of Manganese at Different Temperatures. Moment of the* Mn'' *Ion.* **G. Foëx** and **(Miss) A. Brunet.** (Comptes Rendus, 184. pp. 443–445, Feb. 21, 1927.)—An ion may have moments varying by a few Weiss magnetons, and the Mn'' ion has been observed with values 28 and 29. The substance $Mn_2P_2O_7$ has been tested in the temperature interval between − 80° and 485°, and is found to follow Weiss's law: $\chi(T - \theta) = c$. The atomic moments found for two series of determinations were 30·05 and 30·07 magnetons. The constancy of the magnetic properties of this substance justify its choice as a magnetic standard. G. E. A.

1896. *Magnetic Properties of Evaporated Nickel and Iron Films.* **R. L. Edwards.** (Phys. Rev. 29. pp. 321–331, Feb., 1927.)—The apparatus used was that of Sorensen [see Abstract 1214 (1925)], and films were deposited on aluminium by evaporation of the metals at low pressure from hot filaments. The iron films have a critical thickness of about 50 $m\mu$, such that for films of greater thickness than this there is an abrupt diminution in the coercive force. No such critical thickness was found for nickel. Nickel films when unheated give narrow hysteresis loops; when the films are heated previous to and during deposit their behaviour is similar to that of the metal in bulk as regards magnetic induction, but the retentivity and coercive force are much increased. Iron behaves in a somewhat similar manner. The experiments seem to emphasise the importance of the influence of the crystalline state on magnetic properties. G. E. A.

1897. *Magnetism and Molecular Structure.* **E. C. Stoner.** (Phil. Mag. 3. pp. 336–356, Feb., 1927.)—The susceptibilities of the inert gases and ions of similar configuration are roughly of the same order as those predicted from the ionisation potentials. The helium model with $k = \frac{1}{2}$ for each electron orbit gives a susceptibility one-sixth of that observed; the magnetic data suggest a model with two parallel approximately circular orbits. Except in a few cases the magnetic moments of the ions of the first transition series of elements (paramagnetic) differ from those calculated from Hund's ground terms; the ions with a smaller number of electrons behave magnetically as though they were in S states. The simpler binuclear diamagnetic systems behave like ^1S atomic configurations. The Glaser anomaly for hydrogen is probably not due to a threefold increase in the susceptibility at low pressures due to orientation. Hamar finds no evidence of such a magnetic anomaly, but with imperfectly dried gases obtains curves not unlike Glaser's. The magnetic moments of NO and O_2 (paramagnetic) suggest a sequence with N_2, the three behaving as atom-like configurations in ^1S, ^2S and ^3S states. The magnetic properties can be closely correlated with the chemical, if it is assumed that there are 10, 11 and 12 "outer" electrons surrounding compound nuclei consisting of the atomic nuclei and the remaining electrons, and that ten "outer" electrons, as in N_2, are required for an inert gas atom-like configuration. This arrangement does not agree with that deduced by Birge and by Mulliken from observations of band spectra, this has eight electrons moving in two quantum orbits forming an L group, the Bohr analogue of the Langmuir octet. H. N. A.

1898. *Atomic Moments of Complexes belonging to the Iron Group.* **P. Weiss.** (Comptes Rendus, 184. pp. 417–419, Feb. 21, 1927.)—Certain complexes, such as those of Cr''', Ni'' and Cu'', have the same magnetic moments as the normal ions of the same valency. Others, such as those of Fe'', Fe''' and Co''', have different moments. In the latter case the moments may be obtained from Cabrera's graph of the moments of normal ions and the corresponding number of electrons by taking an abscissa equal to the effective atomic number increased by four. The method of finding the effective atomic number is explained. The rule is illustrated by means of the nickel and iron carbonyls. [See Abstract 971 (1923).] G. E. A.

1899. *Magnetic Moment of the Hydrogen Atom.* **T. E. Phipps** and **J. B. Taylor.** (Phys. Rev. 29. pp. 309–320, Feb., 1927.)—The magnetic properties of the hydrogen atom were investigated by the method of atomic ray deflection due to Gerlach and Stern. A ray of hydrogen atoms was directed on to a target of molybdenum trioxide, passing on its way through three slits. The images formed on the target with and without the application of a magnetic field brought out the separation of rays caused by the field, but this separation is sometimes overshadowed by a diffuse central ray. A tentative explanation of these effects is offered. The value found for the magnetic moment of the atom was 6050 gauss-cm., or about 8 % higher than the magneton value calculated on the basis of Bohr's theory. Hydrogen, activated by exposure along with mercury vapour to ultra-violet light, was also tested, and it was concluded that in this case the active substance consisted, not of atomic hydrogen, but of short-lived excited hydrogen molecules. G. E. A.

1900. *The Magnetic Susceptibilities of O_2 and N_2.* **F. J. v. Wiśniewski.** (Zeits. f. Physik, 41. 4–5. pp. 385–394, 1927.)—A mathematical calculation of the magnetic moment of a two-atom molecule of oxygen, based on an atomic model already described [see Abstract 2260 (1926)], and on Langevin's expression for the susceptibility, leads to correct values of paramagnetic susceptibility. The solution is also applied to diamagnetic molecules, such as those of nitrogen, and the susceptibilities of such molecules are proportional to the fourth powers of their quantum numbers (n), *viz.*, $\chi = -0 \cdot 624\, n^4 \times 10^{-10}$ for monatomic molecules and $-1 \cdot 369\, n^4 \times 10^{-10}$ for diatomic molecules. G. E. A.

1901. *Critical Survey of Recent Advances in Diamagnetism.* **E. S. Bieler.** (Frank. Inst., J. 203. pp. 211–241, Feb., 1927.)—A useful compendium of recent work on atomic structure with particular reference to diamagnetic properties. The survey begins with Langevin's work, and proceeds to that of Bohr, Stoner and Pauli. Symmetrical electron structures are then considered in relation to diamagnetism. The work of Pascal and others on the susceptibility of the elements is next reviewed, and an attempt is made to connect the magnetism of diamagnetic elements with such properties as the crystalline structure, the electrical conductivity, the Hall effect, the behaviour of the atom in a magnetic field, the dimensions of electronic orbits and the quantum numbers of Pauli's scheme of atomic structure. G. E. A.

1902. *Hourly Character Figures of Magnetic Disturbance at Kew Observatory, Richmond,* 1913–1923. **J. M. Stagg.** (Meteorolog. Office, Geophys. Mem. 4. No. 32. pp. 1–24, 1926.)

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1903. *Some Experiments in the Production of Rapid Serial Skiagrams from the Screen Image by Means of a Cinematographic Camera.* **R. J. Reynolds.** (Brit. J. of Radiology, 23. pp. 33–43; Disc., 43–44, Jan., 1927.)—The article is an account of experiments extending over five years (May, 1921–December, 1926) with a view to obtaining direct cinematographic skiagrams of the moving parts of the body by photographing a fluorescent screen image with a cinematographic camera especially adapted for the purpose. Films were obtained of the limbs in one-eighth and of the thorax in one-quarter of a second dense enough to show detail clearly. A special feature is made of synchronising the action of the X-ray tube with the movements of the shutter of the camera so as to minimise the risk of X-ray exposure to the subject under examination AUTHOR.

1904. *Standardising the Denomination of the Capacity of Diagnostic Tubes.* **H. Franke.** (Brit. J. of Radiology, 23. pp. 134–138; Disc., 139, 1927.)—To define the capacity of X-ray tubes the author proposes the use of the ratio of apparent kilowatts to the area of the focal spot, when the energy is applied for one second without damage to the tube. A line focuselectron tube is then described in which the effect of a point source of radiation is obtained by use of a line focus on the tube target, which gives a point source of radiation when regarded from an appropriate perspective angle. An automatic self-focussing tube is also described in which the electron beam is controlled, as regards its cross-section, by the repulsive effect of a more negative central rod electrode. The effect upon the electron stream area, and therefore the focus on the tube target, varies automatically with the applied energy. In the *Discussion*, **Bouwers** pointed out that the proposed definition of the capacity of X-ray tubes, whilst correct for a constant potential, does not consider the mean values when fluctuating voltages are employed. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1905. *Adsorption Equations. Review of the Literature.* **E. Swan** and **A. R. Urquhart.** (J. Phys. Chem. 31. pp. 251–274, Feb., 1927.)—A comprehensive review of both theoretical and empirical considerations under the headings: Nomenclature, evaluation of the quantities, classification; the general adsorption equation; the isotherm; the isobar; the isostere; rate of adsorption; heat of adsorption; note on the formulation of adsorption laws. T. H. P.

1906. *Studies in Adsorption.* **S. Ghosh** and **N. R. Dhar.** (J. Phys. Chem. 31. pp. 187–206, Feb., 1927.)—Continuing the work published in previous papers [see Abstract 2464 (1926)], the authors have extended their investigations on the influence of concentration of the sols of antimony sulphide, stannic hydroxide, (positive) manganese dioxide, (positive and negative) aluminium hydroxide, thorium hydroxide, vanadium pentoxide, prussian blue, uranium ferrocyanide, gum dammar, gamboge, sulphur (Weimarn), gold and silver, towards their coagulation by various electrolytes. The results showed that the sols of antimony sulphide, prussian blue, gum dammar, and gamboge do not follow the general dilution law when coagulated by univalent and sometimes by bivalent ions. Positively charged manganese dioxide sol required a greater amount of silver nitrate or cuprous chloride to coagulate it in the diluted condition than in the concentrated. The abnormal behaviour is due to the marked adsorption of Ag and Cu ions by manganese dioxide. F. J. B.

1907. *Adsorption of Basic Dyes by Filter Paper.* **S. Mokruschin** and **O. Essin.** (Kolloid Zeits. 41. pp. 104–105, Feb., 1927.)—On placing a drop of a basic dye solution on filter paper, the distance to which the ring of clear medium spreads beyond that of the dye is a measure of the degree of electrical absorption of the dye through the neutralisation of the positive charge of the dye by the negative charge of the paper. This relation can be expressed by the equation of Schmidt $a = c \,.\, \frac{D^2 - d^2}{d^2}$, where a is the amount of absorbed dye per unit surface, c the initial concentration of the solution, and D and d the diameter of the inner and outer rings in millimetres. An equation which is deduced for the relation between adsorption, when assumed to be electrical, and concentration is of the form $a = S(1 - \frac{1}{2}^{\beta})$, where S is a constant depending on the surface of the adsorbent, and $\beta = 8C_v/C_\infty$, where C_v is the initial concentration of the solution and C_∞ the concentration which gives maximum adsorption. Measurements are made with malachite green, diamond green, rosanilin, safranin, and methylene blue at varying concentrations. The values of S determined from the above equation are approximately constant for a given dye. J. N. P.

1908. *Adsorption Phenomena.* **S. Mokruschin** and **O. Essin.** (Kolloid Zeits. 41. pp. 106–107, Feb., 1927.)—The equation derived [see preceding Abstract] to express the relation between polar adsorption and concentration for electrolytes is tested in its application to the results of published data for the adsorption by charcoal of argon, carbon monoxide, bromine, and a number of electrolytes. The equation is employed in the form $a = S(1 - \frac{1}{2}^{\beta})$, where, with gases, $\beta = 8p_v/p_\infty$, p_v and p_∞ being the partial pressures. The values of a are compared with those calculated by the adsorption equation of Fruendlich. A satisfactory agreement is obtained in all cases between measured and calculated values. The results indicate that in these chemical adsorptions the molecules behave as bipoles, presenting a surface of free ions which in adsorption are neutralised by a layer of oppositely-charged ions occurring at the surface of the adsorbent. J. N. P.

1909. *Theory of Heat of Adsorbtion.* **H. Cassel.** (Phys. Zeits. 28. pp. 152–153, Feb. 1, 1927.)—The author criticises the recent paper of B. Iliin [Abstract 804 (1927)], and discusses the thermodynamic grounds for the theory and points out that the theory of Iliin is untenable. F. J. B.

1910. *Molecular Combination and the Molecular Volumes of Mixtures of Ether and Hydrogen Bromide.* **J. Russell** and **W. E. Sullivan.** (Roy. Soc. Canada, Trans. 20. 2. pp. 301–306, 1926.)—Measurement of the molecular volumes of mixtures of ether and hydrogen bromide give results which are best explained on the assumption that the major part of the deviations from Raoult's law is due to the formation of a molecular compound undergoing very little dissociation in the solution. The few vapour-pressure measurements yet made on these solutions support this view. T. H. P.

1911. *Numerical Data on Colloids.* **G. Rebière.** (Tables Annuelles de Constantes et Données Numériques, Paris, 5. pp. 1261–1288, 1926. Extract.)—Part I deals with the properties of solid colloidal substances, and is subdivided into sections on the absorption of water and of other liquids, in which data are given on the swelling, liquefaction, isoelectric points and osmosis effects with some typical gels in water, various acids and their salts; absorption of different gases by charcoal and other solids, including electrodes and precipitates; peptisation of ferric arseniate and phosphate; mutarotation; action of finely-divided substances on freezing points; elasticity of jellies as a function of pH values.

Part II deals with the properties and reactions of colloidal solutions, and comprises sections which give data on viscosity and the influence of medium, size of particle and effect of added agents, coagulation, emulsions, soaps, electric synthesis of colloids, specific inductive capacity of colloidal solutions, cataphoresis of water in organic liquids, absorption of light by colloids, surface tension of various colloidal solutions, dilatation of aqueous solutions of gelatine, density of colloidal solutions. J. N. P.

1912. *Theory of Lyophilic Colloids.* **M. Volmer.** (Zeits. phys. Chem. 135. 1–2. pp. 151–157, Jan., 1927.)—A discussion is given of the thermodynamic relations which determine the nature of the dispersion of a liquid which forms a saturated solution with a second liquid. An expression is derived for the energy of formation of a colloidal particle in terms of its dimensions and the boundary-surface potential σ. The Clausius-

Clapeyron equation is applied in the form $dlnZ_n = u/kT^2 \, . \, dT$, where Z_n is the number of particles containing n mols. or of radius r per c.c., and u is the heat of formation of particles of the dispersed liquid. In determining from this the distribution of size of colloidal particles, the relation between the maximum number of particles and radius is given by $r_{(Z\ \mathrm{max.})} = \sqrt{\frac{kT}{8\pi\sigma}}$. By selecting a value of T = 300° C. and $\sigma = 0{\cdot}001$ dyne a calculation is made of the number of particles of different sizes, and the distribution is shown by means of a graph plotted to give $Zr = r \, . \, \varepsilon^{-4\pi r^2 \sigma/kT}$ as ordinate against $ln \, . \, r$ as abscissa. Sharply defined peaks indicate the predominating size of the particles, and beyond this the curves fall rapidly to zero for larger sizes of particles. By applying an equation which gives the influence of dilution on size of particle it is shown that the predominating size of particle is displaced towards the smaller sizes, and the total concentration of particles or osmotic pressure falls to a much smaller degree than the change in concentration. A breaking down of the larger particles thus occurs on dilution and on concentrating aggregation results. Saturation point may not be reached when gel properties are attained. A state of supersaturation is conceivable when solid particles fail to aggregate on account of the absence of mobile molecules. J. N. P.

1913. *Viscosity Methods with Variable Rate of Flow and a New Viscometer (Overflow Viscometer).* **W. Ostwald** and **R. Auerbach.** (Kolloid Zeits. 41. pp. 56–62, Jan., 1927.)—The various forms of apparatus hitherto used for pressure viscometry of colloidal solutions are compared and discussed, and a new and improved type is described. The methods of measurement and calculation of results are demonstrated with cotton-yellow (Baumwollgelb) sols. An illustration of the new apparatus is given, and the numerical results are shown in numerous tables and curves. [See Abstract 2606 (1924).] E. F.

1914. *Colloid Chemistry of Viscous Solutions. The Velocity Function of Viscosity.* **T. Mukoyama.** (Kolloid Zeits. 41. pp. 62–71, Jan., 1927.)—Pressure viscometry measurements of glycerine were made with a new type of Ostwald and Auerbach viscometer [see preceding Abstract] and found to be in agreement with the Hagen-Poiseuille law. The absolute value of viscosity was calculated and proved to be fairly constant. The same method was applied to the measurement of viscous solutions of different age. They all show "structural viscosity." "Structural turbulence" appears with medium maturity. The absolute value of the velocity of this structural turbulence diminishes with increasing age of the solutions. Numerous tables are given. E. F.

1915. *Viscosity Measurements on Cotton-Yellow (Baumwollgelb).* **W. Ostwald** and **R. Auerbach.** (Kolloid. Zeits. 41. pp. 112–122, Feb., 1927.)—Measurements of the viscosity of cotton-yellow, containing about 1·2 %, in the presence of sodium sulphate, showed a well-marked maximum and two less definite maxima at lower concentrations. The viscosity measurements were made with a capillary viscometer and with an overflow viscometer at different velocities of flow and pressures. Mixtures of gelatine and sodium sulphate showed a maximum at the same point and also the lesser-marked maximum. The maxima and minima are shown by cotton-yellow sols, containing salts, on heating and cooling. Solutions over 2 % behaved in the opposite manner, in that the first anomaly was shown on cooling and the latter on warming. The phenomena were ascribed to the similar causes like the viscosity phenomena of critical liquid mixtures, crystalline liquids, molten sulphur, and at the coagulation temperature of egg albumen, the swelling of starch suspensions. Sols of cotton-yellow show remarkable and regular diminution in viscosity after mechanical treatment. F. J. B.

1916. *Action of Metals on Thixotropic Sols and Gels.* **H. Freundlich** and **W. Rawitzer.** (Kolloid Zeits. 41. pp. 102–104, Feb., 1927.)—An investigation is made of the influence of metals on the phenomenon of thixotropy whereby sols of certain metallic oxides which have been coagulated by the addition of an electrolyte become liquid again on shaking. Solidification occurs again on allowing to stand for definite intervals. If the sol is allowed to remain in contact with a metal for a few days prior to the addition of the electrolyte, the time subsequently required for solidification of the thixotropic gel is, in some cases, reduced from 6000 to 4 seconds. The effect cannot be due to metallic kations as salt of the same metals are without effect, or to OH′ ions, but is attributed to the influence of local currents generated by the metals on the properties of the sol. The influence of metals is particularly marked with sols of iron oxide and cerium dioxide which possess several oxidation stages. An influence similar to that of contact with metals is exercised by the application of either direct or alternating current. The phenomenon is considered to bear an analogy to the influence of thunderstorms in affecting the colloidal condition of milk and latex. J. N. P.

1917. *Coagulation of Sols of Ferric Hydrate by Electrolytes with Polyvalent Anions.* **A. Boutaric** and **(Miss) M. Dupin.** (Comptes Rendus, 184. pp. 326–327, Feb. 7, 1927.)—Coagulation of a ferric hydrate sol of 1·6 g. per litre by sodium phosphate only occurs when the concentration of the latter is between 2×10^{-4} N and 5×10^{-4} N, or when above 2×10^{-2} N. With increasing concentration of the sol the lower range of coagulation values is displaced towards higher concentrations and the upper limiting value is lowered. No appreciable influence is exerted by sulphuric acid or potassium hydroxide. Small amounts of ferric chloride cause an increase of the limiting values. The presence of the colloids starch, dextrine, albumin, or gelatine cause a narrowing of the coagulation concentrations until finally the lower range disappears and coagulation only occurs above a critical value. J. N. P.

1918. *Preparation of Metallic Colloids.* **E. Fouard.** (Comptes Rendus, 184. pp. 328–329, Feb. 7, 1927.)—The elements arsenic, iodine, tellurium, mercury, lead, copper, and antimony are brought into a colloidal condition by electrolysis of solutions of their salts in presence of an organic colloid such as albumin, starch, or gelatine. The colloidal metal is dispersed in cloud form in the neighbourhood of the kathode and is probably formed by the discharge of the metal ions on the surface of the colloidal micellæ so as to form an organo-metallic complex. Reference is made to the conditions most favourable to their formation and to their physical properties. J. N. P.

1919. *Ageing of Gelatine.* **A. Nagorny.** (Kolloid Zeits. 41. pp. 123–130, Feb., 1927.)—The viscosity of gelatine solutions, measured at 20° C., increases or diminishes according as the solutions are kept at 6° or 37° C., but if the measurements are made at 30° C. approximately the same values are obtained in the two cases. At 30° C. both gelatine solutions which have been kept at 6° and 30° C. follow Poiseuille's law approximately, whereas at 20° C. this is the case only with the latter. Gum arabic solutions aged at 37° and 6° C. respectively exhibit nearly equal viscosities. Gelatine solution aged at 37° C. requires more ammonium sulphate for precipitation than that aged at 60° C. for an equally prolonged time, but if the former solution is subsequently kept for a long time at 6° C. the amount of the sulphate required diminishes. By fractionation with ammonium sulphate it is possible to divide gelatine solution aged at 6° C. into two fractions of different viscosities, only one of these gelatinising at room-temperature. In the cold the gelatine solution probably forms coarse disperse particles responsible for the formation of jelly, these persisting at 20° C. but passing into solution in a fine disperse condition at 30° C. The coarse and fine disperse phases may be identical chemically and different only as regards degree of dispersion, but it seems more probable that a chemical difference exists. T. H. P.

1920. *New Process for Ornamenting Aluminium and its Alloys.* **L. Guillet.** (Comptes Rendus, 184. pp. 134–136, Jan. 17, 1927.)—Pacz has recently found that immersion of aluminium or an alloy rich in aluminium in a bath containing 5 grammes of sodium fluosilicate, 10 of crystallised nickel sulphate and 25 of potassium nitrate per 4 litres of water, best at 70–80°, results in the appearance on the metal of more or less coloured lines which blacken rapidly in the liquid. The designs obtained may be varied by modifying the conditions of the action, for instance, by moving either the liquid or the metal. The deposits composing the markings seem to have their origin in the impurities present in the metal, but a uniform coating is not obtainable by prolongation of the action. The fact that the treated metal loses weight when heated in a current of hydrogen points to the presence of nickel oxide in the deposit. T. H. P.

1921. *The Allotropes of Tin.* **A. Travers** and **Houot.** (Comptes Rendus, 184. pp. 152–155, Jan. 17, 1927.)—There are three allotropic varieties of tin: (1) rhombohedral—density 6·55; (2) quadratic—density 7·28; (3) grey tin—density 5·8. After a note on the present state of knowledge the results of the authors' experimental work on the subject are given. The calorimetric method due to Pionchon for the study of iron and nickel, was used to determine the reason for the inflexion in the cooling curve in the neighbourhood of 165°, as noted in the dilatometric measurements of Chevenard. The present work shows, in certain cases, a discontinuity in the curve about 170°–171° C., and this is attributed to the previous history of the material. The tin, heated to 350° C. for some minutes and afterwards cooled, did not show the discontinuity, but if heated at 500° C. for two hours, the inflexion was observed. The effect of impurities was insignificant, and identical results were obtained from commercial and pure tin. Various other experimental results are described. S. G. B.

1922. *Anomalous Internal Friction of Ferro-Nickel.* **P. Chevenard.** (Comptes Rendus, 184. pp. 378–380, Feb. 14, 1927.)—A study of the internal friction of ferro-nickel, and its variations with temperature and content of nickel was made. The temperatures ranged from 0° to 400° C., and it was found that the decrement of tenacity reached a maximum at 38 % Ni. The abnormal behaviour is explained by the existence of the α and β phases, which are subject to reversible transformations, and stable at different temperatures. F. J. B.

1923. *Thermal Anomalies of Certain Solid Solutions.* **P. Chevenard.** (Inst. of Metals, J. 36. pp. 39–62, 1926.)—Certain metallic feebly magnetic solid solutions show transformations which are similar to those of ferromagnetic substances in that they occur without change of phase, they are spread over a range of temperatures, they are subject to relatively slight hysteresis and result in anomalies in certain physical properties. They differ from the magnetic transformations in that the temperature of their occurrence does not vary appreciably with change of composition. Evidence is given of these so-called X transformations in α copper-aluminium, nickel-chromium and copper-nickel solid solutions, and a detailed study is made of their effect on the dilatation of the first two groups of alloys and on the resistivity of the last. The variation of the position and magnitude of these anomalies with change of composition is noted, and the coefficients of dilatability and resistivity of each temperature over a wide range have been determined in some cases. C. O. B.

1924. *Decomposability and Explosibility of Chloride of Lime and Calcium Hypochlorite.* **H. Kast** and **L. Metz.** (Zeits. Elektrochem. 33. pp. 21–39, Jan., 1927.)—The explosions of chloride of lime reported in the literature mostly refer to cases in which closed containers have been burst owing to evolution of gas either of long duration or enhanced by the action of external heat. In the experiments now described, use has been made of various specimens of chloride of lime, containing active chlorine in different proportions, and of "perchloron," which consists of highly pure calcium hypochlorite containing a little free calcium hydroxide. The results obtained show that neither high-grade chloride of lime nor perchloron can be regarded as explosive, but that in highly unfavourable cases they may serve as oxygen-carriers of the type of potassium, sodium and barium nitrates and thus lead to explosions. From these nitrates they are distinguished in that they yield their oxygen at lower temperatures. They are, however, fairly stable at ordinary temperatures, and their stability is increased by addition of lime. There is less danger with perchloron than with chloride of lime, either during transport or from contact with organic substances. T. H. P.

1925. *Influence of Cold Treatment on the Velocity of Evaporation. Melting and Transformation Points of Cold-worked Metals.* **F. Sauerwald, H. Patalong** and **H. Rathke.** (Zeits. f. Physik, 41. 4–5. pp. 355–377, 1927.)—Results previously obtained [Abstract 2031 (1923)] suggested that the process of the cold working of metals must give rise to an increase in the mobility of the atoms in the space-lattice. Experiments now made with zinc and silver show that evaporation of cold-worked metal is more rapid than that of the metal previously heated to redness. With zinc it is found that sheet with large crystallites exhibits a lower rate of vaporisation than that with small crystallites. As regards the increased facility for the change of position in crystallites due to cold-working, it is pointed out that exchange of atoms between homogeneous space-lattice regions results from a favourable mutual orientation of planes of maximum amplitude of vibration and velocity of crystallisation; that the increase of the atoms with especially large amplitudes of vibration is effected in consequence of the elastic deformation of parts of the lattice; that the manifold subdivision of the lattice by glide-planes produces at the latter many atoms with not quite regular relations to the limiting homogeneous space-lattice region; that a widespread subdivision by glide-planes creates small unstable lattice regions with appreciably higher vapour pressure, and hence greater chances of escape, than corresponds with the normal condition. T. H. P.

1926. *Activation of Gases by Adsorption.* **G. B. Kistiakowsky.** (Nat. Acad. Sci., Proc. 13. pp. 1–4, Jan., 1927.)—A method is proposed for testing the presence of activated molecules or catalytic surfaces by measurements of the heat of adsorption. Using a calorimeter specially designed for maximum sensitiveness, curves are obtained for the heats of adsorption of H on an active catalyst and on a catalyst poisoned by a small amount of O respectively, and for the heat of adsorption of CO on the active catalyst. An explanation is given of the results obtained which is in good agreement with previous studies on the relation between adsorptive capacity and catalytic activity and on the action of catalytic poisons; but more conclusive indications are found that a portion of adsorbed gas is activated by the action of fields of force surrounding the unsaturated surface atoms. A. B. C. L.

1927. *Formation of Films of Lead Sulphide on Glass Surfaces.* **H. L. Smith.** (Journ. Sci. Instruments, 4. pp. 115–118, Jan., 1927.)—Solutions of this carbonide and lead tartrate are made up and used in a particular way, the process being based on the formation of lead sulphide from the interaction of alkaline sulphide and an alkaline solution containing lead. The character of the film deposited on the glass depends on the composition of the glass and on the initial treatment of its surface. G. E. A.

1928. *Actinic Absorption of Chlorine Gas, with Respect to the Hydrogen Chlorine Reaction.* **W. Taylor.** (Faraday Soc., Trans. 23. pp. 31–37, Jan., 1927.)—An experimental study is made of the reaction velocity between H and Cl, produced in an actinometer of the type used by Bunsen and Roscoe, by an intense beam of white light which is first passed through a filter of Cl gas under various conditions. The anticatalyst effects of oxygen are described and found to be in accordance with the theories of inhibiting agents advanced by previous workers. By varying the concentration of the absorbing medium the general form of the actinic absorption curves is established. A greater ease of transmission by the Cl than has previously been supposed is indicated. The

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shape of the curve is such as to disfavour the idea that only a narrow range of frequencies is effective in promoting activation. It is indicated that in addition to those frequencies which Cl gas is able to absorb readily, activation may be produced by rays which pass through thicknesses of the order of 50 cm. and then produce an effect of about 10 % of the full reaction velocity under white light. A. B. C. L.

1929. *Residual Effect in the Actinic Absorption of Chlorine.* **W. Taylor** and **A. Elliott.** (Faraday Soc., Trans. 23. pp. 38–41, Jan., and Disc., p. 107, March, 1927.)—Experiments on lines similar to those previously described [see preceding Abstract] are carried out, in which the gaseous Cl filter is replaced by a filter consisting of solutions, of various concentration, of Cl in CCl_4. The curves obtained, although exhibiting certain differences as yet unaccounted for, agree in showing a "residual" effect—*i.e.*, the activating power of the light after passing through large concentrations of Cl is greater than would be expected were the light monochromatic and absorbed in accordance with an exponential law. The character of the curves suggests that certain types of radiation present in ordinary white light are only feebly absorbed by Cl and are yet able to give rise to an appreciable amount of activation. A. B. C. L.

1930. *Oxidation of Phosphorus Vapours at Low Pressure.* **M. Bodenstein.** (Zeits. f. Physik, 41. 6–7. pp. 548–560, 1927.)—This paper consists of remarks on a paper on this subject by Chariton and Walta [see Abstract 1207 (1927)]. In that paper the authors described experiments from which they concluded that the reaction between phosphorus vapour and oxygen at low pressures comes to a stop when the oxygen pressure has sunk to a "critical pressure." This interpretation of the observations is scarcely in accord with our knowledge of chemical reaction velocities, and doubt is thrown on the observations themselves. A. E. G.

1931. *Gaseous Reaction between Hydrogen Sulphide and Sulphur Dioxide.* **H. A. Taylor** and **W. A. Wesley.** (J. Phys. Chem. 31. pp. 216–230, Feb., 1927.)—The kinetics of the reaction are studied by a dynamic method, the gases being allowed to flow through pyrex reaction tubes at temperatures ranging from 370–730° C. and the velocity of combination calculated from a determination of the composition of the mixed gases leaving the chamber. The velocity is found to be proportional to the surface area of the reaction chamber, showing that the glass surface acts as a contact catalyst for the reaction. The temperature coefficient decreases with rise of temperature. The velocity of combination at constant temperature varies directly as the partial pressure of the SO_2 and as the partial pressure of the H_2S raised to the power of 1·5. The results substantiate a suggestion for a mechanism of reaction in harmony with modern theories of heterogeneous reactions, according to which each of the reactants is activated by adsorption on the surface of the glass, reaction then following between the activated molecules only.
A. B. C. L.

1932. *Chemical Action in the Electric Spark Discharge. Ignition of Methane.* **H. F. Coward** and **E. G. Meiter.** (Am. Chem. Soc., J. 49. pp. 396–409, Feb., 1927.)—The amount of reaction is measured in air-

methane mixtures when single electric sparks just insufficient in strength to ignite the mixture are discharged between platinum terminals and the volume of gas burnt during each discharge is found. The products of reaction in all cases were carbon monoxide, carbon dioxide, hydrogen and water. There is approximate agreement between the volume of gas burnt during each spark discharge and that calculated by the method of Fourier (Theorie de la Chaleur, par. 385) from the energy of the spark, the thermal conductivity and the ignition temperature of the mixture. It is concluded that the action of the spark is thermal in character and does not involve any electric effect. The methane flame must have a definite thickness, the first lamina of which includes the formation of carbon monoxide and water, the last chiefly of carbon dioxide. Non-inflammable methane mixtures, subjected to similar sparking, suffered dissociation into acetylene, hydrogen and carbon; from the volume changes in such mixtures it is deduced that a spark passing in an explosive mixture is able to cause the direct dissociation of one quarter as many methane molecules as it causes to burn. [See Abstract 1886 (1926).]
L. M. C.

1933. *Methane Equilibrium. Part IV.* **R. C. Cantelo.** (J. Phys. Chem. 31. pp. 417–418, March, 1927.)—By means of the data previously given [Abstract 1574 (1927)], the decrease of free energy attending the synthesis of methane from amorphous carbon and hydrogen is calculated to be 14,500 calories. T. H. P.

1934. *Existence of Silver Hydroxide in the Solid State.* **H. L. Riley.** (Phil. Mag. 3. pp. 459–464, Feb., 1927.)—The water present in precipitated silver oxide after prolonged desiccation is probably there in the form of a surface film of silver hydroxide. This view is in conformity with the size of the individual particles of silver oxide and with the chemical inactivity of the substance when treated with carbon dioxide, and can be correlated quite simply with theories of crystal structure. T. M. L.

1935. *Self-Oxidation and Anti-Oxidation Action. Experiments under Heat. Application to the Problem of the Mechanism of the Action of Anti-Detonators.* **C. Moureu, C. Dufraisse** and **R. Chaux.** (Comptes Rendus, 184. pp. 413–417, Feb. 21, 1927.)—Self-oxidation under heat is defined as the union of an entire molecule of oxygen O_2 with a molecule of a self-oxidisable body A to form a primary peroxide AO_2, which subsequently will decompose with the formation of stable products of oxidation. The phenomenon of self-oxidation, *i.e.*, the existence of peroxides, has been observed with paraffinoid hydrocarbons, naphthalene, and hydrogenated naphthalene, petrol, animal and vegetable oils, and the influence of a wide range of anti-detonating agents on the phenomenon has been observed. It is concluded that "knocking" in an internal combustion engine is due to the explosive decomposition of these peroxides formed in the liquid, not the gaseous, phase; the effect of antiknock compounds such as lead-tetraethyl or triphenylamine is to prevent the formation of these peroxides in the liquid phase. B. W. C.

1936. *Quasi-Unimolecular Reactions. Decomposition of Ethyl Ether in the Gaseous State.* **C. N. Hinshelwood.** (Roy. Soc., Proc. 114. pp. 84–97, Feb. 1, 1927.)—The decomposition of gaseous ethyl ether is a reaction which follows the unimolecular law at high pressures, but becomes more nearly bimolecular at lower pressures [see Abstracts 823 and 824 (1927)]. The velocity of the reaction is represented by the equation

$$\log_e k = 26\cdot47 - \frac{53{,}000}{\mathrm{KT}}.$$

If hydrogen is added in sufficiently high proportion, the diminution of the unimolecular velocity constant at low pressures is completely prevented; helium and nitrogen have little or no influence in this direction, but the products of the reaction, in considerable excess, exert a slight retarding effect. If the energy of activation is assumed to be distributed among about eight degrees of freedom, there are sufficient collisions to activate the molecules. These and other quasi-unimolecular reactions are most simply explained on the basis of Lindemann's theory [see Abstract 110 (1923)], but further evidence is needed to confirm such an interpretation. A table is given showing the relationship between the complexity of a molecule and the type of mechanism by which it decomposes. Simple molecules usually decompose bimolecularly, and more complex ones in a quasi-unimolecular manner, as might be expected on theoretical grounds. T. H. P.

1937. *Kinetics of the Partial Processes in the Landolt Reaction.* **A. Skrabal** and **A. Zahorka.** (Zeits. Elektrochem. 33. pp. 42–63, Feb., 1927.)—A reply to criticisms of Skrabal's paper [see Abstract 1612 (1924)] by Thiel, Eggert and others who objected to the many time constants and other points. The authors agree that the three more or less simultaneous stages of the Landolt reaction should be studied kinemetrically also in their isolated or pure condition. The stages are :—

(1) $IO_3' + 3SO_3'' \rightarrow I' + 3SO_4''$.
(2) $IO_3' + 6H^{\cdot} + 5I' \rightarrow 3I_2 + 3H_2O$.
(3) $3I_2 + 3SO_3'' + 3H_2O \rightarrow 6I' + 6H^{\cdot} + 3SO_4''$.

As regards (2)—studied particularly by Dushman, 1904, and quite recently by E. Abel and F. Stadler [Zeits. phys. Chem. 122. pp. 49–80, 1926] from the standpoint of Brönsted's theory of reaction velocity and Debye's theory of strong electrolytes—the authors adduce new experimental material. The reaction becomes isolated when a substance is present capable of rapidly removing the iodine or the ion I_3', or reducing it to I', without acting on the iodate. Such a substance is arsenious acid. The experiments are made with arsenious acid dissolved in acetic acid and sodium acetate, and also with arsenate solutions. The second dissociation constant of arsenic acid is found to have the value $1\cdot6 \times 10^{-7}$ at 25°, at which all the experiments were performed. The measurements accord with those of others. The reaction velocity depends upon the first power of the iodate and upon the second powers of the ions of iodine and of hydrogen. The reaction (1), which represents the sum of (2) and (3), was traced over the whole *p*H range, but only the range 4 to 13 was found to be of use for the determination of the time constants. The time constants depend upon (1) and (2). H. B.

1938. *Activity Coefficients of the Ions in Certain Phosphate Solutions. Contribution to the Theory of Buffer Action.* **E. J. Cohn.** (Am. Chem.

Soc., J. **49.** pp. 173–192, Jan., 1927.)—The theory of buffer action has been extended by consideration of the activity coefficients of the ions into which the salts of weak acids dissociate. By combining the Henderson-Hasselbalch equation for buffer action with the Debye-Hückel equation for the activity coefficient of an ion the expression

$$\mathrm{P_H} - \log\,[(\mathrm{salt})/(\mathrm{acid})] = \mathrm{P_K} - 0\cdot5\sqrt{\mu}/(1 + \mathrm{K}b) + \mathrm{K}s\mu$$

was obtained. The phosphate standards measured by Sorensen can be calculated by the expression

$$\mathrm{P_{H+}} + \log\,[(\mathrm{KH_2PO_4})/(\mathrm{K_2HPO_4})] = 7\cdot16 - 1\cdot5\sqrt{\mu}/(1 + 1\cdot5\sqrt{\mu})$$

with an accuracy of 0·01 $\mathrm{P_H}$. The second dissociation constant of phosphoric acid was found to be 7·16 for $\mathrm{P_K}$ and $\mathrm{K}a_2 = 0\cdot69 \times 10^{-7}$. Electromotive force measurements were made upon mixtures of potassium dihydrogen phosphate and dipotassium phosphate of concentrations up to 1·2 M. F. J. B.

1939. *Activity Coefficients of Electrolytes. Part I. Limiting Law for a Tri-Trivalent Salt. Part II. Unsymmetrical Valence-Type Effect in Highly Dilute Solutions.* **V. K. la Mer, C. V. King** and **C. F. Mason.** (Am. Chem. Soc., J. **49.** pp. 363–374, Jan., and pp. 410–426, Feb., 1927.)—Part I. The solubility of hexammino cobalt ferricyanide in solutions of potassium nitrate, magnesium sulphate and sodium chloride are determined. In each case, increase in solubility exists, and the activity coefficients are calculated and used to investigate the validity of Debye and Hückel's law. This law appears to conform closely for low dilutions of potassium nitrate and magnesium sulphate. Variation from the theoretical values of α' determined by the equation $\alpha' = 1/2\cdot303[\mathrm{N}^2\epsilon^3\sqrt{2\pi}/(10\mathrm{RD_0T})^{3/2}]$ (where $\mathrm{D_0}$ is the dielectric constant for the pure solvent) occurs in the case of sodium chloride. This deviation is greater than can be accounted for on the simple Debye-Hückel conception of ionic size. Part II. The activity coefficients of hexammino cobalt tetranitrito diammino cobaltiate and of hexammino cobalt dinitrito diamminodioxalto cobaltiate are determined from solubility measurements in salt solutions. Where the salts have univalent anions (potassium nitrate, barium chloride and sodium nitrate) agreement exists with Debye and Hückel's limiting law. With salts having multivalent anions (potassium sulphate, magnesium sulphate, potassium ferro- and ferricyanides) marked divergencies exist, and the experimental curves for such salts show no tendency to become identical with the theoretical curve at very low concentrations. Such deviations are considered to be caused by neglect of the higher terms in the Debye-Hückel expression for the density of electricity. By expansion of the higher terms, a qualitative agreement for ionic size is obtained where the simpler theory would require impossible negative values. Bjerrum's hypothesis of ionic association [Kgl. Danske Videnskab, Math-fys. Medd., 1926, 7, 9] gives an explanation of the data. [See also Abstract 1608 (1924).] L. M. C.

1940. *Anodic Overvoltage Measurements with the Kathode-Ray Oscillograph.* **E. Newbery.** (Roy. Soc., Proc. **114.** pp. 103–111, Feb. 1, 1927.) —The behaviour of a series of metallic anodes in dilute sulphuric acid is investigated with the aid of the kathode-ray oscillograph. Unattackable electrodes and passive electrodes (when in the passive state) show the phenomena of overvoltage and transfer resistance similar in all respects to those observed during kathode treatment. Lead is classified with the passive electrodes together with nickel, iron and chromium, and lead dioxide is regarded as an overvoltage compound. Chromium is readily rendered passive with respect to the formation of trivalent ions, but is still active with respect to the formation of hexavalent ions. Passivity is attributed to the formation of an insoluble electrical conducting coating of an overvoltage compound which may or may not form a solid solution in the electrode surface. Valve action, as shown by antimony, tantalum and bismuth, is attributed to the formation of an insoluble electrically insulating coating of oxide or other compound forming the dielectric of a condenser of which the plates are electrode and electrolyte. The capacity of such condensers may be of the estimated order of a microfarad per square centimetre. The thickness of the coating in the case of antimony is calculated to be of the order of 4×10^{-5} mm., and in the case of tantalum it is probably of the order of 10^{-6} mm. It is suggested that the action of an electrolytic rectifier may be due partly to the condenser action outlined above and partly to the oxide film acting as a semi-permeable membrane, permeable only to hydrogen ions. [See also Abstract 2489 (1926).] J. N. P.

1941. *Electrometric Study of the Precipitation of Silicates.* **H. T. S. Britton.** (Chem. Soc., J. pp. 425–436, Feb., 1927.)—The reactions between silicic acid and sodium hydroxide or the alkaline earths in solution and those between solutions of typical metallic salts and sodium silicate were investigated by means of the hydrogen electrode. The mode of ionisation of silicic acid cannot be expressed in terms of dissociation constants, but it was found that the reactions of silicic acid with stronger bases have a pronounced effect on the hydrogen-ion concentration of the solutions. Sodium silicate, Na_2O, $2(16SiO_2)$, with metallic salts yields precipitates which contain less silica than is required for metasilicates. The silicate precipitates were formed at a hydrogen-ion concentration of less than $pH = 7$. The results were applied to the question of soil acidity. F. J. B.

1942. *Absolute Electrolytic Solution Tension. Part II. Electrocapillarity Curve of Mercury.* **K. Bennewitz** and **A. Delijannis.** (Zeits. phys. Chem. 125. pp. 144–150, Jan., 1927.)—The electrocapillarity curve of mercury in pure mercurous chloride solutions is found to be a parabola with the apex at $\epsilon_H = + 0{\cdot}475$ volt, corresponding with the absolute zero of the electrolytic potential found by Bennewitz and Schulz.
T. H. P.

1943. *Transverse Electrocapillarity Effect.* **T. Takeuchi** and **H. Akashi.** (Phys. Math. Soc. Japan, Proc. 8–10. pp. 192–194, Nov., 1926. In English.)—The effective surface tension at the boundary of two liquids is reduced by the contact potential difference. This effect can be increased, diminished or reversed by an appropriate applied e.m.f. An alternating e.m.f. is applied between two drops of electrolytes on the surface of mercury, and the drops vibrate in the period of the alternations, expanding and contracting under the influence of the varying surface tension. G. A. S.

1944. *Equilibrium of Heterogeneous Systems, including Electrolytes. Part II. Equilibrium at Interfaces and the Theory of Electrocapillarity.* **J. A. V. Butler.** (Roy. Soc., Proc. 113. pp. 594–605, Jan. 1, 1927.)—In continuation of previous investigations [see Abstract 251 (1927)] the conditions of equilibrium at the interfaces in a heterogeneous system containing electrolytes are determined by the method of Gibbs. A detailed analysis is made of the changes produced by electrolytic polarisation at the interface between Hg and solutions of electrolytes. A theory of electrocapillarity is developed, including the effect of capillary-active substances, based on the equations of equilibrium. The integration of the equations requires the introduction of kinetic considerations, and a kinetic theory is developed of the adsorption of ions and the effect thereof on the electrocapillarity curves. The equations are in good agreement with the data for KI solutions. A. B. C. L.

1945. *Physical Chemistry of Complex Salts. Part I. Transport Numbers of Copper Salicylate.* **W. E. Hamer** and **C. R. Bury.** (Chem. Soc., J. pp. 333–338, Feb., 1927.)—By means of the Hittorf migration method measurements are made of the transport numbers of copper salicylate in aqueous solution. The value obtained for the transport number of the kation 0·626, and the fact that the value does not change with concentration, indicates that the salt ionises in aqueous solution as a normal salt. From the fact, however, of the very slow and only partial precipitation of copper hydroxide on adding alkali, it is concluded that the compound is present as the salt of a complex pseudo-acid H_2 Cu Sal_2, the stability of which is determined by the hydrogen ion concentration in accordance with the equilibrium $2H + (Cu\ Sal_2)'' \rightleftharpoons Cu^{\cdot\cdot} + 2H\ Sal'$. J. N. P.

1946. *Electroendosmosis and Electrolytic Water Transport.* **H. C. Hepburn.** (Phys. Soc., Proc. 39. pp. 99–107, Feb. 15, 1927.)—This paper gives the results of determinations of liquid transport produced by passing an electric current through aqueous solutions of copper sulphate divided perpendicular to the flow of electricity by a diaphragm of powdered glass. The probable factors that determine the liquid transport are investigated over a wide range of concentrations by an examination of the dependence of the flow at constant applied voltage and of the electric charge of the diaphragm on the electrolyte concentration, and also by a study of the relation between the flow per Faraday and the dilution of the electrolyte. AUTHOR.

1947. *Mechanism of Cataphoresis.* **G. Ettisch** and **D. Deutsch.** (Phys. Zeits. 28, pp. 153–154, Feb. 15, 1927.)—A potential field of 100 to 1000 volts is applied to the two ends of a rectangular strip of unglazed porcelain or moistened parchment paper which have a resistance of the order of 10^5 ohms/cm. A drop of the colloidal solution under investigation is then placed on the strip and the change in form observed. According to the magnitude and polarity of the charge on the colloid, one half of the liquid becomes clear and the other half coloured, the colloid particles migrating to one edge and finally coagulating to give a segment with the appearance of a half-moon. Measurements are made with the positively charged sol of ferric hydroxide and the negatively charged vanadium pentoxide. J. N. P.

1948. *Behaviour of the Quinhydrone Electrode in Solutions of Neutral Copper Sulphate.* **J. B. O'Sullivan.** (Faraday Soc., Trans. 23. pp. 52–56, Jan., and Disc., pp. 106–107, March, 1927.)—As observed in a previous paper [see Abstract 1166 (1926)], the potential of the quinhydrone electrode in solutions of neutral $CuSO_4$ exhibits a pronounced drift with time, continuing to change very slowly even up to seven days. Experiments are carried out from which it is concluded that this drift of potential is not due to oxidation of the quinhydrone nor to the formation of complexes between the Cu ions and the organic material. Examination of the precipitates formed from $CuSO_4$ and quinhydrone, or hydroquinone, suggests that the variation of potential and the gradual production of a precipitate containing Cu are due to the formation, and slow hydrolysis, of cuprous sulphate. A. B. C. L.

1949. *Absolute Values of Electrode Potentials.* **Marie Andauer.** (Zeits. phys. Chem. 135. pp. 135–143, Jan., 1927.)—The new method described for determining absolute values of electrode potentials is based on the relation between the current in a uniformly ionised gas and the potential difference between two parallel metal plates bounding the gas. From this relation an unknown p.d. between the plates may be determined by measuring the corresponding current. It seems possible also to ascertain similarly the p.d. between a metal and a liquid, for if the one plate is replaced by the free surface of the solution, while the other is connected with the metal dipping into the solution or this is used as the second plate, the measurement of the current in the gas gives the p.d. between the liquid and the immersed metal. It is found that, for a first approximation, the p.d. arising at the contact of metal with gas, liquid and gas, or metal and metal may be neglected. Apparatus is described for putting this method into practice. Preliminary measurements of the electrode potential between a decinormal calomel electrode and a normal hydrogen electrode give satisfactory results. T. H. P.

1950. *Electrical Conductivity of Solid Silver Nitrate.* **L. Piatti.** (N. Cimento, 3. pp. 405–420, Dec., 1926.)—The results here obtained show that the conductivity of crystals of nitrate of silver obtained by resolidifying the fused salt is principally due to the existence of humidity in their interstices if particular care has not been taken to completely desiccate them. Therefore also the conductivity proper of a perfectly dry crystal of nitrate of silver is purely electrolytical. A. E. G.

1951. *Valve Action of Silver.* **A. Güntherschulze.** (Zeits. f. Physik, 40. 11–12. pp. 876–882, 1927.)—Silver exhibits in solutions in water of $KAg(CN)_2$ an electronic valve action of the same kind as Zn and Cd in solutions of K_2CO_3 or Sb and Bi in most electrolytes. The formation sets in after a period of latency which increases with decreasing density of formation current. The velocity of formation is proportional to the current density, decreases with the concentration of the electrolyte, and is only slightly dependent on the temperature of the electrolyte. The spark potential is somewhat less than that of tantalum in the same solution. If the silver anode is exposed for a time to a tension less than the spark potential the current sinks asymptotically to very small values. Resistances of more than 10 million ohms per sq. cm. of surface were indicated. The electrostatic capacity of the layer dependent upon the valve action is very much smaller than with tantalum, and is not accurately measurable. J. J. S.

1952. *Preparation of Colloidal Silver Haloids by Electrolysis.* **T. Wereide.** (Zeits. f. Physik, 41. 11–12. pp. 864–866, 1927.)—When a halogen hydracid is electrolysed with the aid of silver electrodes, colloidal silver haloid is formed at the anode as a pale cloud which moves towards the kathode with a velocity approximately equal to that of the hydrogen ion. Addition of agar-agar depresses the mobility to the normal value for colloids. This phenomenon appears also with about the same velocity when alternating current is used. T. H. P.

1953. *Electrolytic Deposition of Chromium from Aqueous Solutions of Chromic Acid.* **E. Liebreich.** (Zeits. Elektrochem. 33. pp. 69–72, Feb., 1927.)—Commenting on E. Müller [see Abstract 2994 (1926)], the author points out that the patent of Salzer, 1907, was not sustained and had no importance, and that his own patent and researches of 1920 were prior to, or at least simultaneous with, Sargent [see Abstract 1640 (1921]. Any impurity, even sulphuric acid, increases the tendency of chromium to complex formation. For some unknown reason the chromium deposits adhere better when chromium sulphates or sulphuric acid is added to the chromic acid; sodium sulphate is still more advantageous. H. B.

1954. *Electrolytic Deposition of Chromium from Aqueous Solutions of Chromic Acid.* **E. Müller.** (Zeits. Elektrochem. 33. pp. 72–76, Feb., 1927.)—Müller rejects the historical claims of Liebreich [see preceding Abstract] and deals with his objection at length. The reduction of chromic acid at carbon kathodes sets in at + 0·8 volt, whether sulphuric acid be absent or present. If Liebreich objects to the simultaneous presence of Cr(6) and Cr(2)—the numbers in parentheses indicating the valency—on the side of the oxide diaphragm turned towards the kathode, he should also object to this coexistence on the other side, and Müller does not see why Cr(6) should not be reduced to Cr in one step without the intermediate formation of Cr(2) in measurable concentration. H. B.

1955. *Electrochemical Behaviour of Chromium. Part III.* **G. Grube and G. Breitinger.** (Zeits. Elektrochem. 33. pp. 112–114, March, 1927.)—Continuing the previous investigation [Abstract 1725 (1926)], the equilibrium potential Cr/Cr in solutions of chromium sulphate was determined. The results obtained by assuming that the degree of dissociation of chromous sulphate was the same as that of copper sulphate at the same concentrations gave $\epsilon_h = - 0\cdot557 \pm 0\cdot007$ as the most probable value for the normal potential of Cr/Cr at 19° C. For the change Cr^{++} (+) Cr^{+++} the value $\epsilon_h = - 0\cdot412 \pm 0\cdot002$, and from these two values the normal potential of the change Cr + 3 (+) Cr^{+++} the value $\epsilon_h = - 0\cdot509$ was obtained. F. J. B.